
DESIGN TO WIN

PHILANTHROPY'S ROLE IN THE
FIGHT AGAINST GLOBAL WARMING



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© California Environmental Associates

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EXECUTIVE SUMMARY



How can philanthropists turn the tide against global warming? Never before have donors, foundations, policymakers and the general public confronted such a complex, far-reaching crisis. Left unattended, human-induced climate change could overshadow all our other efforts to cure diseases, reduce poverty, prevent warfare and preserve biodiversity. Global, collective action is paramount. The stakes – and hurdles – could not be any higher.

As scientific evidence of climate change has become clearer and more compelling, the prescription for changing course seems to have become more muddled and mysterious. Philanthropists who are concerned about climate change are inundated with a dizzying array of often contradictory options and opinions. Should they back renewable power sources, such as wind and solar, or try to clean up coal-fired plants? Given the global scale of the predicament, where in the world should they allocate their precious resources? Which philanthropic investments will get the most carbon out of the atmosphere?

To chart a course through this maze, we surveyed the scientific literature and economic research, including the Stern Review, Vattenfall climate abatement map prepared by McKinsey & Company and reports by the Intergovernmental Panel on Climate Change. We also sought the input of more than 150 of the world's leading experts on energy and climate change. Hailing from more than a dozen countries and every continent except Antarctica, these scientists, policy analysts, conservationists and government officials constitute an impressive brain trust with diverse perspectives on climate issues. With these experts' guidance, we developed an exhaustive list of possible interventions and used existing mitigation models to quantify each strategy's expected cost and emissions reduction. Our investigation was overseen by a dedicated group of scientific advisors and representatives from seven major foundations (members of both committees are listed on the preceding page).

As we prioritized the initiatives, we were guided by philanthropy's comparative advantages. Politicians are fixated on the next election; CEOs are focused on next quarter's numbers. Philanthropists, by contrast, have longer time horizons and can tolerate more risk. Besides being more patient investors, philanthropists have a strong tradition of filling gaps, spurring step-changes in technology and pursuing programming that transcends both national boundaries and economic sectors. Such capacities are exactly what are needed to tackle global warming.

While this investigation does not address adaptation to climate change, philanthropy must recognize that global warming's repercussions are likely to be

most acute in nations where poverty is chronic; conversely, the richer nations which have done the most to change our weather are also the best equipped to deal with climate change's consequences.

Because at least some global warming is inevitable, foundations must not neglect programs that address adaptation, especially in the nations which have the fewest resources to cope with changing conditions.



OUR CONCLUSIONS

Our analysis yielded a short list of the initiatives with the most potential to set the world on a low-carbon path. Four overarching priorities orient our investment road map:

- First, don't lose – the battle could be lost in the next decade.** Catastrophic climate change – far worse than anything we have experienced – will be unavoidable if we don't prevent a massive “lock-in” of emissions from new coal-fired power plants, long-lived industrial infrastructure, inefficient buildings, car-centric cities, and irreversible deforestation (Figure 1). The First Rule of Holes: when you're in one, stop digging.
- We must concentrate our efforts geographically.** Global, collective action is critical for reducing the numerous drivers of climate change, but philanthropy must focus its efforts. Our search for substantial carbon reductions leads us to the U.S., E.U., China and India. The U.S. and E.U. – which are responsible for more than one-third of greenhouse gas emissions, both currently and cumulatively¹ – must take the lead and pioneer new technologies. In China and India – where per capita emissions are one-sixth and one-thirteenth the U.S level, respectively – there is still time to influence energy investments and the shape of booming mega-cities, where the greatest mitigation potential lies. To address tropical deforestation, we must also look to remote jungles in the Amazon, Congo and Indonesia. Furthermore, when it comes to the critical task of putting a price on carbon, we should invest where national and international politics demand.
- Policy reform is essential for tempering climate change.** A cap on carbon output – and an accompanying market for emissions permits – will prompt a sea change that washes over the entire global economy. Putting a price on carbon will help spark innovation and the clean technology markets needed to

¹ Cumulative emissions are for the 1950-2000 period.

prevail in the long term. The global community must overcome the collective action problems that have hobbled international climate agreements. But a carbon price alone won't be enough to keep emissions in check for two reasons. First, more than 30 percent of essential mitigations will be more expensive than the likely carbon price. Second, low-carbon interventions are likely to be slowed by non-price barriers, such as perverse subsidies, principal-agent problems, counterproductive utility regulations, and inefficient channels for both information and investment in research and development. Sector-specific policies are also needed to complement carbon pricing.

▪ **Our interventions also must target five sectors that play a leading role in greenhouse gas emissions.** There are no silver bullets – we must simultaneously act on a number of fronts in each sector. The threat of lock-in and our geographic/emerging cities focus narrowed the field of options to the most urgent interventions (Figure 2):

- **Power:** Emissions from existing coal plants should be reduced and new investments in coal-fired generating stations should be discouraged by stressing efficiency and renewable alternatives, such as wind and solar. But when coal plants are unavoidable, they must be built to capture and sequester carbon emissions.
- **Industry:** National and/or sector-specific carbon caps are absolutely essential for reining in top emitters, such as steel mills and cement plants. Improving the emissions profile of mid-market companies – which are collectively as dirty as top emitters – demands utility reform, adoption of international “best-practice” technology, and new standards for the motors, pumps, boilers and other “universal” equipment systems found in most every factory.
- **Buildings:** New buildings and appliances, properly engineered, offer three times the carbon reduction potential as retrofits. Realizing this potential will require broad adoption of national and provincial building codes and appliance standards that are adequately enforced. New, low-cost technologies now available in the U.S. and E.U. must become prevalent around the world. Utility reform will accelerate retrofits and turnover of existing buildings and appliances.
- **Transportation:** New efficiency and fuel standards will cause vehicles to go farther on less gas and emit less carbon. These benefits, however, will be neutralized if vehicle use continues to soar. Better mass transit and smarter urban growth are needed to ensure that tens of millions of new cars stay parked. There's no reason why the architectural creativity on display in places like Shanghai can't be complemented with imaginative urban planning that creates the next generation of sustainable, low-carbon mega-cities.

FIGURE 2: Design to Win (DTW) Interventions Address ~11 Gigatons (Gt) of Mitigation

Strategies		Mitigation potential GtCO ₂ e	
		Global	DTW
Power	Minimize need for coal	0.1*	0.1*
	Promote alternatives to coal power	2.3	1.5
	Accelerate CCS for unavoidable coal	2.0	1.3
Industry	Reduce emissions from largest emitters and sectors	1.8	1.2
	Improve efficiency of “universal” equipment to reach both large and small emitters	1.2	0.6
Buildings	Avoid lock-in of energy-intensive new buildings and appliances	3.0	1.7
	Retrofit existing buildings and accelerate appliance turnover	1.0	0.6
Transport	Improve vehicle efficiency	1.3	0.7
	Decarbonize fuels	1.2	0.7
	Contain growth in vehicle miles traveled (VMT)	0.3	0.2
Forestry	Promote local markets and incentives for non-carbon ecosystem services	} 2.0	2.0
	Reduce incentives driving deforestation		
	Promote global carbon finance mechanisms to compensate for avoided deforestation and degradation		
Policy	Ensure adoption of aggressive, well-designed carbon policy		
	Establish prerequisites for implementation of carbon policy		
	Expand funding for and cooperation on key technologies		
		~ 16 Gt	~ 11 Gt

* Only includes accelerated retirement; does not include 3.7 Gt from demand-side efficiency counted under buildings and industry
Source: Mitigation potential adapted from IPCC, USEPA, Vattenfall

- **Forestry:** A robust international market for carbon offsets must provide residents of tropical forests with a financial incentive to keep trees standing and bolster long-standing efforts to remove the drivers of deforestation.

To achieve our goal of reducing 2030 emissions by 30 gigatons, we must *simultaneously* search for mitigation opportunities in each of these sectors. Unless we reshape these building blocks of the world economy, the Earth’s climate will undergo its most rapid and profound transformation since the last Ice Age.

Our survey of the philanthropic field identified current annual funding of about \$200 million for climate issues, with only a portion devoted to the Design to Win priorities listed above. This amount pales in comparison to the \$3.2 billion U.S. foundations invested in health programs in 2004 alone, and the \$3.1 billion devoted annually to education.² Based on our interviews with climate and energy experts, we estimate that additional funding of about \$600 million is needed annually to implement Design to Win’s strategies.

We recommend, in the broadest of terms, a three-part menu of investments:

1. Support existing NGOs with deep knowledge of local conditions and needed strategies; cultivate new organizations where necessary.

² According to the Giving USA Foundation.

2. Create nation-specific expertise to facilitate grant making. Organizations that have the local capacity and expertise are needed to oversee highly leveraged, strategic interventions.
3. Build International Best Practice Centers for critical “don’t lose” sectors to accelerate the diffusion of knowledge and innovation, either by establishing new institutions or linking existing organizations in loose networks.

FIRST, DON'T LOSE



Our investigation produced a chilling conclusion: if we don't act boldly in the next decade to prevent carbon lock-in, we could lose the fight against global warming. The urgent need to avoid locking in emissions is a function of how our biosphere behaves. Carbon dioxide (CO₂) and other heat-trapping gases persist in the atmosphere for centuries, so decisions made in the next 5 to 10 years will alter the Earth's climate for generations to come. Our best hope for staying in the game is to limit new sources of greenhouse gases so that technological breakthroughs can save us down the line.

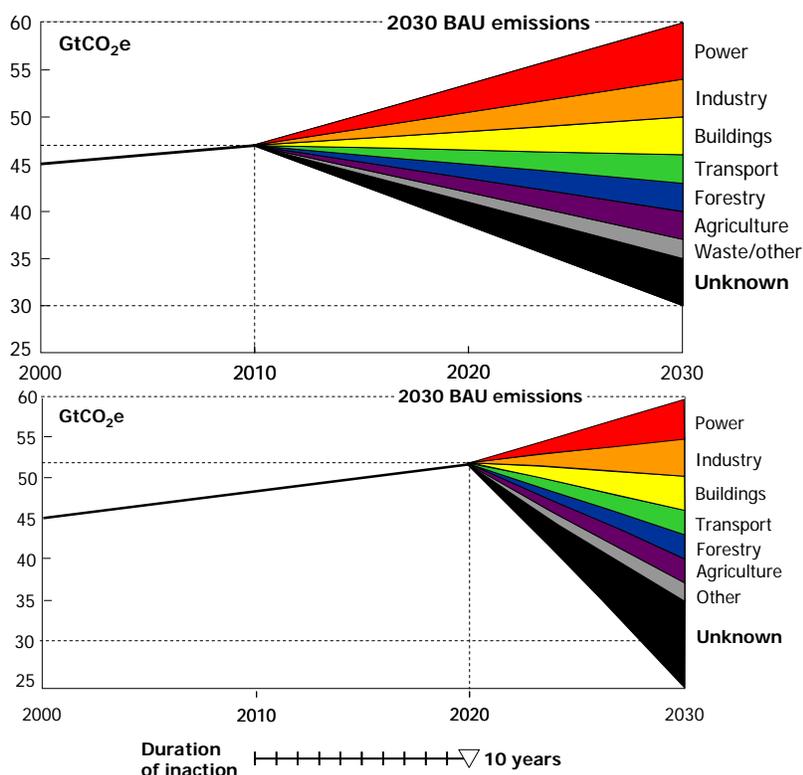
New coal plants are the most troublesome source of lock-in. China is now building the equivalent of two, 500-megawatt coal plants *every week*. Each of these new generating stations will operate for more than 50 years and bequeath a legacy of greenhouse gas emissions to our children and grandchildren. Future modifications to coal-fired plants could allow traditional designs to sequester at least some of their emissions, but retrofits will be cost prohibitive in the near-term so these facilities should be designed with carbon capture technologies in mind.

New factories, offices, stores and homes threaten to lock-in still more carbon emissions if they're not designed correctly. In some cases, retrofits and updates can ameliorate the impact – but at a steep price. As with coal plants, a better option is to do the job “right” the first time.

If we fail to catalyze the world economy today, the challenges will be that much greater tomorrow (Figure 3). They may even become insurmountable. Each

FIGURE 3: A Delay Will Cost Us Dearly

2030 emission reduction potential by sector



Source: IPCC and USEPA, 2006 (2030 potentials)

year the status quo persists, the task gets tougher: the amount of emissions reduction needed will rise; at the same time, the share of mitigation we can identify will fall. If we don't immediately confront lock-in, even a dramatic scale-up of emissions-free technologies, such as wind and solar, won't allow us to catch a train that's leaving the station – and picking up steam.

WHERE TO FIND 30 GIGATONS?

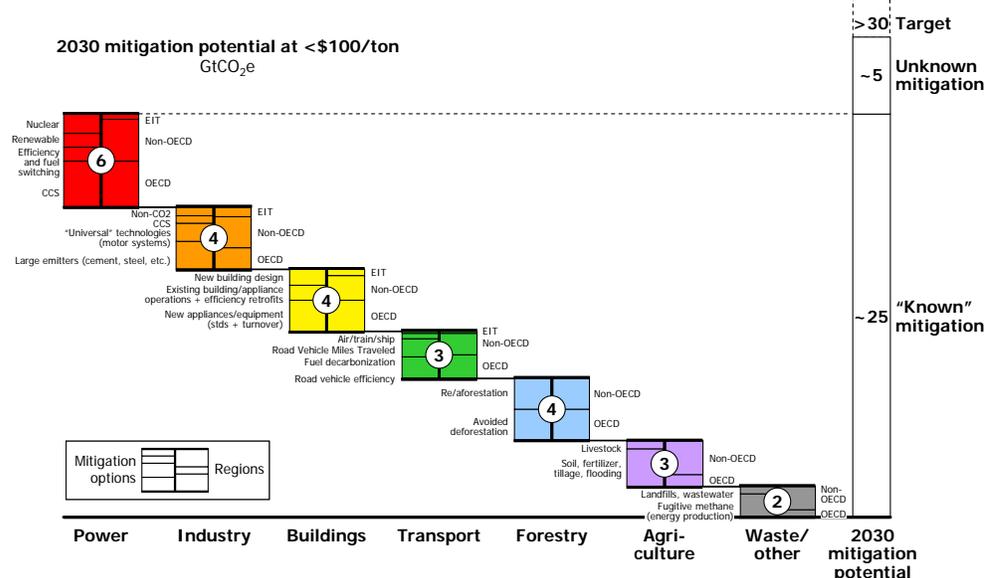


Solving the climate change conundrum will require a makeover of the global economy that is unprecedented in both scope and speed. To prevent the planet’s mild fever from becoming a life-threatening illness, we must reduce annual greenhouse gas emissions by a staggering 30 gigatons (Gt) by 2030. That’s about how much carbon the world emits today, and about half of what’s expected by 2030 if development and energy consumption continue apace.

The good news is that we already have the technology and know-how to achieve these carbon reductions – often at a cost-savings. Design to Win’s synthesis of the latest scientific and economic analyses, including the Stern Review, Vattenfall climate abatement map prepared by McKinsey & Company, and reports by the Intergovernmental Panel on Climate Change, concluded that about 80 percent of the needed mitigation – 25 gigatons of carbon – can be achieved with existing technologies (Figure 4). The key lies in rapidly deploying such technologies in our power plants, buildings, factories and vehicles, and improving land management practices.

Philanthropy can play a pivotal role in this transformation. But donors and foundations must be strategic and choose interventions with the most potential to set the world on a low-carbon course. By filtering the options according to their cost, mitigation potential, geographic focus and, most importantly, their potential to prevent lock-in, Design to Win has yielded an initial set of focused

FIGURE 4: Multiple Mitigation Efforts Required



Source: IPCC and USEPA, 2006 (2030 potentials); IEA ETP Map and Vattenfall (detailed breakdowns); team analysis (large uncertainties for most estimates)

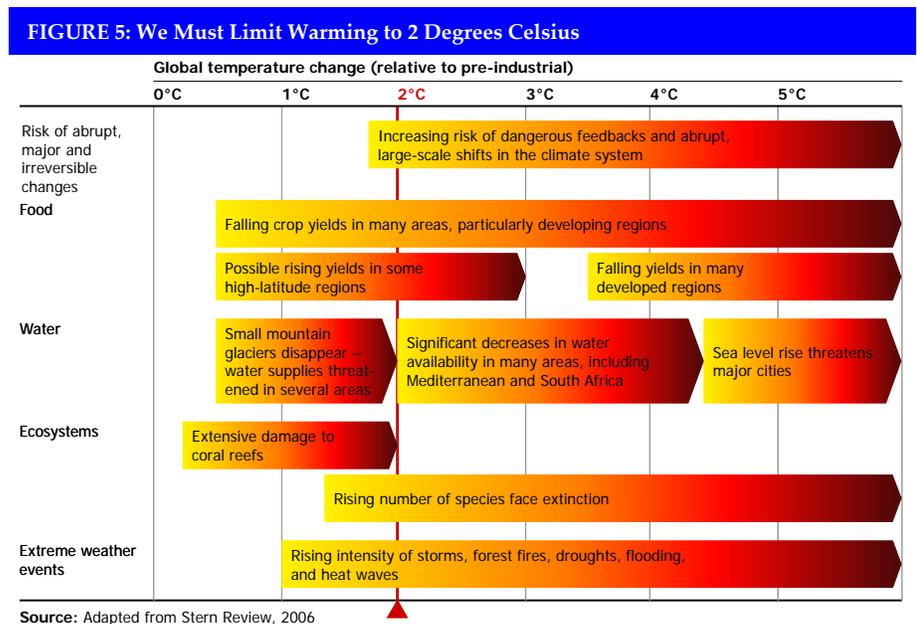
philanthropic investments that can forestall 11 gigatons of emissions. These investments are designed to be catalytic – to blaze the path toward the 30 gigatons needed. But these gains will only be realized if we start acting right now.

DEFINING THE WIN: 2 DEGREES AND 450 PPM

The 30-gigaton mitigation target is derived from widely used climate change projections. Warming that has already occurred – close to 1 degree Celsius – is damaging coral reefs, affecting crop yields, melting glaciers and transforming polar-regions. Far greater impacts are expected if the planet heats up further (Figure 5). Many experts believe that 2 degrees Celsius of warming represents a critical threshold, beyond which the planet faces an increasing risk of calamity in the form of extreme weather, coastal flooding, water shortages, species extinction, agricultural collapses, and economic dislocation. At some point, our warming planet may cross a tipping point. As polar ice caps melt into the sea and the chemistry of the ocean shifts, feedback loops and synergistic forces could hastily remake our world.

To prevent the planet from warming more than 2 degrees, the atmospheric concentration of greenhouse gases cannot exceed the equivalent of about 450 parts per million (ppm) of CO₂.³ To put that figure in perspective, CO₂e levels have already increased by one-half, from a pre-industrial level of 280 ppm to about 430 ppm today.

“Business-as-usual” models predict that CO₂e levels are trending toward 550 ppm in 2040 – nearly double the concentration at the dawn of the Industrial Revolution.

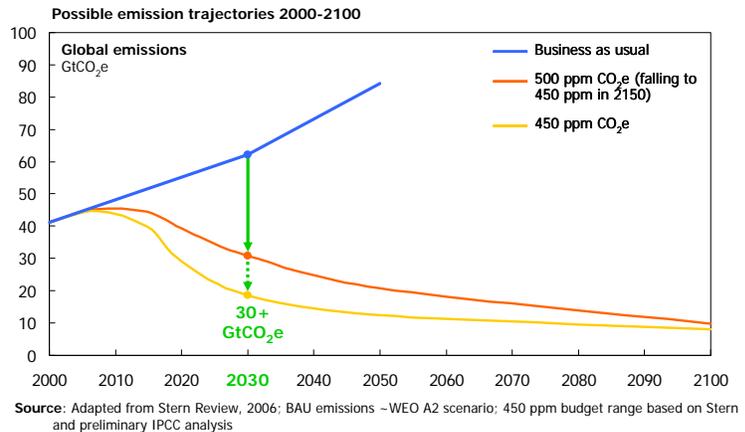


³ Hereafter, we use CO₂e to refer to CO₂ equivalent, a measure of the global warming potential of all greenhouse gases – including methane, nitrous oxide and hydrofluorocarbons – expressed in terms of CO₂. As a rough rule of thumb, CO₂e levels are 50 ppm higher than levels of CO₂ alone.

Atmospheric science tells us that to stabilize CO₂e levels at 450 ppm, we must reduce emissions by *at least* 30 gigatons in 2030 (Figure 6).

It's a tall order: we must figure out how to satisfy the needs and wants of a rapidly growing and increasingly affluent population while still halving the amount of carbon we're projected to release into the atmosphere.

FIGURE 6: Stabilizing Emissions Requires a Minimum 30 Gt



NO SILVER BULLET

In order to reduce emissions by at least 30 gigatons, mitigation must be found *in every sector* of the global economy. And within each sector, multiple approaches will be needed. For example, reducing emissions from power generation will require: dramatic improvements in energy efficiency; greater use of wind, solar and other renewables; sequestration of CO₂ emitted from coal plants; conversion of coal-fired power plants to natural gas; and expanded nuclear power. Unfortunately, there is no panacea that will put us in a position to prevail down the line.

While a broad range of measures are needed to set the world on a low-carbon course, philanthropy can't do it all. Donors and foundations must prioritize and hone their interventions.

How to choose among the options? Our analysis employed three main filters to narrow the field to the most critical investments. The first two filters clarify “what” philanthropy must work on; the third filter identifies “where” donors and foundations should intervene:

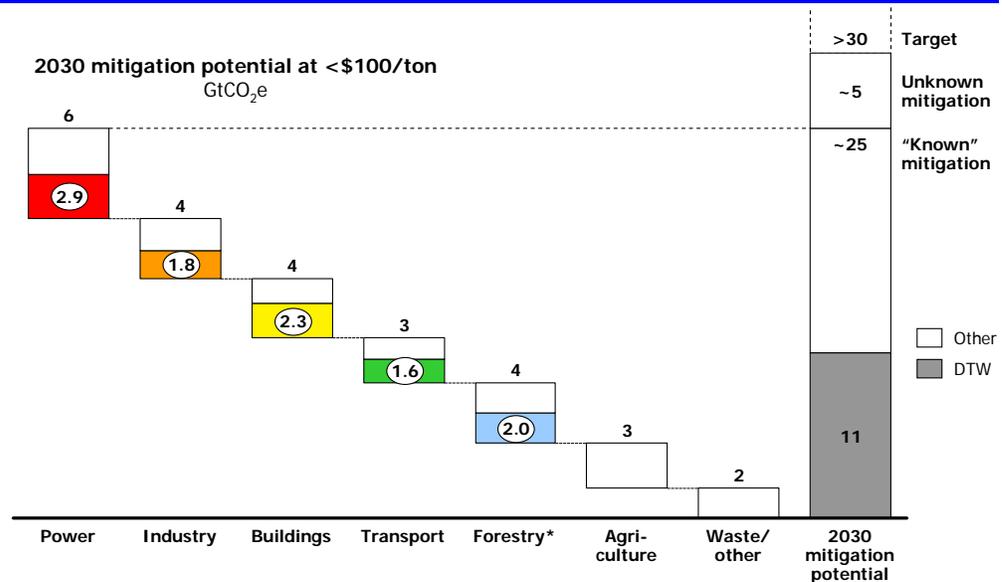
- **Fighting lock-in.** Our first priority is to avoid locking in future emissions with long-lived, carbon-intensive infrastructure, such as new coal plants, inefficient factories, power-hungry buildings and car-centric cities. We also must avoid destroying tropical forests that pull CO₂ out of the atmosphere since these land-use conversions may be permanent, or take decades to undo.
- **Accounting for costs.** The price per ton of avoided emissions helps winnow the field of choices further. Some efficiency gains that are relatively inexpensive – or even cost-negative – remain unrealized. Philanthropy can help remove the non-price barriers that forestall these cost-saving measures, such as better building insulation and hot water heaters. At the opposite end of the cost curve, high prices preclude other measures, such as carbon capture and sequestration. Philanthropy can help lower these costs by working with

businesses, governments, academics and others to develop policies that spur significant new markets and spread knowledge. Many mid-priced efficiency improvements do not warrant direct philanthropic intervention since they will become cost-effective once a carbon price is adopted – a Design to Win priority.

- **Maximizing mitigation in select countries and cities.** Nearly half of the global mitigation potential lies in the U.S., E.U., China and India. All of these “nations” are in the top 5 for CO₂e output, but their per capita emissions vary widely. The U.S. and E.U. – which are responsible for more than one-third of greenhouse gas emissions, both currently and cumulatively – must take the lead. The U.S. alone produces about 25 tons of greenhouse gases per person – 2.5 times as much as the E.U., six times as much as China and thirteen times as much as India. Within these target countries, our focus is on burgeoning mega-cities where emissions intensities – and therefore abatement opportunities – are the greatest. Such opportunities are available in the U.S. and E.U., but even greater potential lie in China and India where there is still time to influence the shape of their booming mega-cities. In the forestry sector, however, our attention centers on tropical nations in the Amazon, Congo and Indonesia.

Applying these screens – and accounting for philanthropy’s comparative advantages – generates a limited set of initiatives that could reduce annual emissions by 11 gigatons, or about one-third of the total mitigation needed to keep the planet from heating up more than 2 degrees Celsius (Figure 7). In the following chapters we discuss the sector-specific interventions after explaining why policy reform is woven through all our strategies for combating global warming.

FIGURE 7: DTW Priorities Address 11Gt



* Forestry: Amazon, Congo, Indonesia (Note: 2.0 = Asia, Africa, etc.); other sectors: US, EU, China, India
 Source: IPCC and USEPA, 2006 (2030 potentials); IEA ETP Map and Vattenfall (detailed breakdowns); team analysis (large uncertainties for most estimates)

POLICY REFORM SPURS CARBON MARKETS

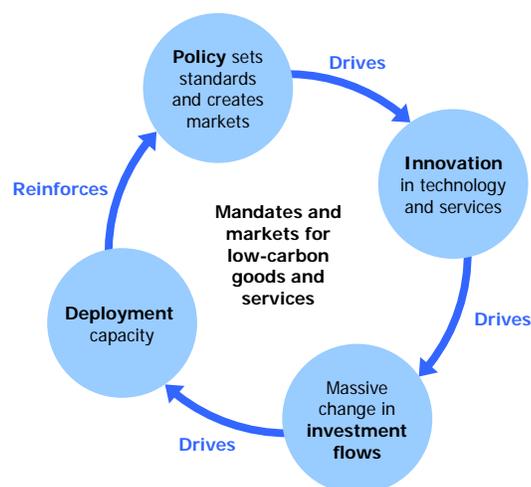


Underlying all our interventions is the urgent need for regulation of greenhouse gas emissions. The sun is setting on an era in which no one bears any responsibility for emitting carbon from tailpipes and smokestacks. Strong financial signals are necessary to spark real collective action. Either through an emissions cap or other means, we must put a price on carbon to force businesses, consumers and governments to pay for their pollution. In turn, investment will shift to cleaner options (Figure 8).

Foundations and others have a long-standing commitment to this policy goal; those efforts finally appear to be paying off. Politicians have never been as serious about tackling climate change and the Group of Eight nations recently established a goal of halving global greenhouse gas emissions by 2050. In the U.S. and E.U., it's not a question of "if" there will be a carbon price and associated market; it's "when" and "how." *And the "how" is absolutely critical because poorly designed carbon policies could constitute the worst lock-in of all.* The Kyoto Treaty and the E.U.'s Emissions Trading System pioneered a global approach to climate policy, brought the issue into the boardrooms of major companies, and helped buy the world a bit more time. But the next round of climate policy must be even stronger and smarter. We must ensure that new carbon caps cover as many major emitting countries and sectors as possible. These caps must be aggressive, afford no easy "off-ramps," rest on meaningful baselines and projections, and be supported by competent national institutions.

Any gains in curbing emissions in the U.S. and E.U. could be eclipsed by rising economies in the developing world. China and India don't want global warming solutions to derail their path to prosperity, especially after richer nations achieved affluence by loading up the atmosphere with greenhouse gases for more than two centuries. Poverty alleviation trumps climate change mitigation. Although developing nations offer some of the greatest mitigation opportunities, these countries cannot – and should not – shoulder the burden. Richer nations, which are the best equipped to deal with the effects of climate change, must help the most

FIGURE 8: Policy Spurs Carbon Markets



vulnerable members of the world community raise their living standards without following the high-carbon path blazed by the U.S. and E.U.

Although poverty in China and India pose challenges for the development of aggressive climate-related policies, some of their national priorities work in our favor: both nations are committed to improving their energy efficiency in order to boost productivity, lessen the health risks of air pollution and become less dependent on foreign energy sources. Even if economy-wide emissions caps are not adopted in China and India, we can still realize huge carbon reductions through sector-specific limits and national efficiency standards. Many such initiatives are underway in China, even if they are not called “climate policy.”

ESSENTIAL ELEMENTS OF A ROBUST CARBON POLICY AND HEALTHY MARKETS

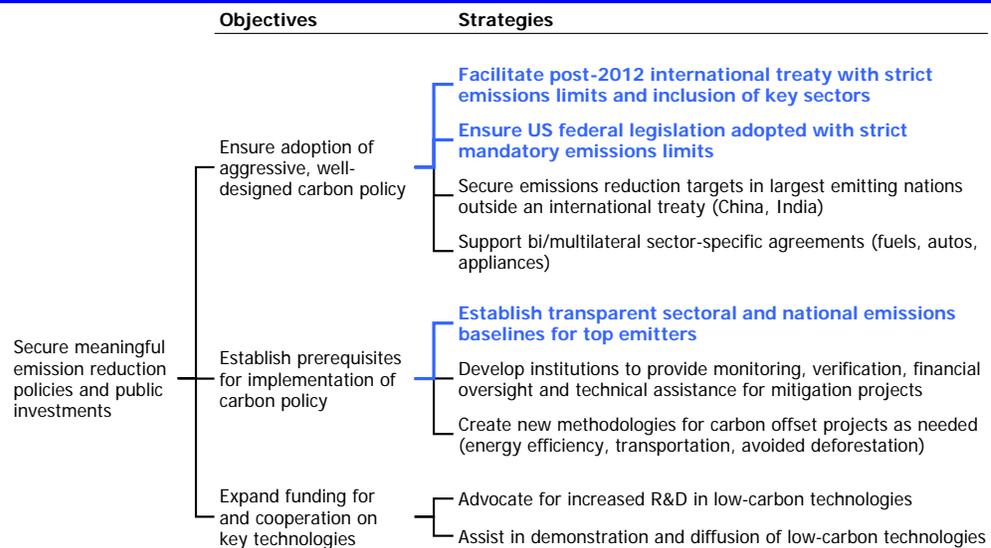
For climate policy to transform the global economy, the pricing of carbon and the associated markets for offsets must be crafted with the utmost of care. The world’s initial foray into this new arena has provided the necessary groundwork, but future policies must be more aggressive and better structured. Existing policies have been undermined by design flaws that yielded anemic markets and insufficient emissions reductions. Philanthropy can help ensure that lessons learned from this first wave of regulation are incorporated into the next generation of climate policy. To effectively control greenhouse gas emissions and keep the planet from warming more than 2 degrees Celsius, we must:

- **Create meaningful carbon caps.** At home and abroad, new policies must limit carbon emissions from a wide range of sectors and activities.
- **Improve policy implementation.** Carbon caps will only work if businesses, governments and other institutions have the capacity to establish rigorous baselines, develop proper projections, monitor emissions and verify compliance.
- **Facilitate R&D cooperation.** Accelerating the development, demonstration and diffusion of low-carbon technologies will allow industries and nations around the world to fulfill their obligations.

Achieving all three objectives is imperative if we are to create an appropriate price on carbon and a healthy market for offsets. Still, philanthropy must be selective as it chooses where to invest its resources in the policy realm. Design to Win has prioritized the options for donors and foundations (highlighted in blue in Figure 9). We have been politically pragmatic – turning away, for instance, from the uphill climb of convincing China and India to adopt carbon caps. Instead, we have chosen strategies with the most immediate catalytic potential.

Philanthropy’s top priority should be the creation of sound carbon regulations at home and abroad that are derived from solid baseline data on emissions and solid projections of future output. This overarching achievement will facilitate

FIGURE 9: Philanthropy’s Role in Carbon Policy (DTW Priorities Highlighted)



progress toward meeting the other two objectives. Carbon caps, prices and markets will generate new government institutions, better methods for measuring and modeling emissions, and technological breakthroughs that will let businesses and consumers do more while emitting less. Accelerating innovation in energy efficiency, a prerequisite for tackling the climate change challenge, is addressed further in the sector-specific initiatives outlined in ensuing chapters.

POLICY PRIORITIES FOR PHILANTHROPY

For philanthropy, three strategies take precedence in the policy arena:

- **Improve international treaties.** Existing international agreements, such as the Kyoto Treaty, its Clean Development Mechanism (CDM) and the E.U.’s Emissions Trading System (ETS), were steps in the right direction, but long-standing collective action problems caused many of these policies to fall short of expectations. The Kyoto Treaty’s post-2012 future remains in doubt and this uncertainty has discouraged action by businesses and governments. The E.U.’s emissions market, while promising at the outset, crashed when excess allowances and more abatement than predicted caused the carbon price to plummet. Given the unprecedented scale and scope of the global warming dilemma, the Kyoto Treaty, CDM and ETS have made significant inroads, but they will not be enough to avert catastrophic climate change unless they are improved upon.

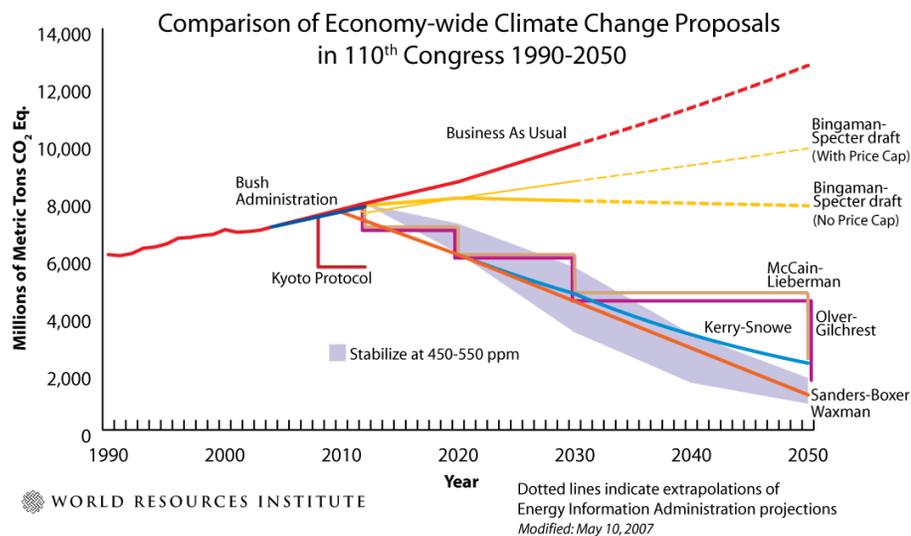
To ensure that the next generation of carbon policy incorporates the lessons of initial efforts, philanthropists should support efforts to:

- Properly quantify baseline and projected emissions of nations, sectors and businesses so that new markets are founded on accurate data and allowances are properly allocated.
- Include critical nations, such as the U.S., China and India, and crucial sectors, such as forestry, so that treaties have a tangible impact on emissions.
- Calibrate emissions caps and targets to stabilize CO₂e concentrations as close as possible to 450 ppm and limit global warming to 2 degrees Celsius.
- Discourage use of pricing “off-ramps,” such as safety-valves and sunset clauses, which can create too many loopholes and make policies ineffective.
- Ensure the policymaking process is fair, inclusive and transparent.

For philanthropy, helping create a new international agreement to succeed the Kyoto Treaty offers the most highly leveraged opportunity because such a deal will cut across so many nations and sectors.

▪ **Create a U.S. policy.** Efforts to combat global warming have been hobbled by the vacuum in U.S. policy. As a leading producer of greenhouse gases – both currently and cumulatively – the U.S. has an inescapable obligation to act on climate issues. Belatedly, the U.S. Congress is now considering several bills that would reduce domestic emissions below business-as-usual projections. As shown in Figure 10, the scope and stringency of these proposals vary widely. Until it was overtaken by China this year, the U.S. was the world’s top emitter of CO₂, so Congress must choose wisely: adoption of a poor U.S. carbon policy would amount to a crippling lock-in of emissions. Foundations must help steer the U.S. toward the best option by using many of the same tactics that will be useful in creating a solid post-2012 treaty:

FIGURE 10: Comparison of Climate Change Proposals, 110th Congress



- Help develop model policies
 - Support analyses of proposed legislation
 - Educate voters, the media and legislators about the tradeoffs.
 - Forge diverse stakeholders into broad coalitions for energy reform
- **Help establish emission baselines and projections.** Problems with existing carbon markets can be traced back to the failure to establish reliable and transparent emission baselines and projections derived from companies' actual carbon output. The next round of baselines and projections must be driven by sound science, open to public comment and geared toward stabilizing CO₂e levels at 450 ppm. There are ample opportunities to build upon existing models for tracking emissions, including ISO 14064 and protocols developed by the Intergovernmental Panel on Climate Change, World Resources Institute and World Business Council for Sustainable Development. These guidelines for measuring emissions must be adopted throughout China and India to track energy consumption and air pollution as first steps toward creating metrics related to climate change.

BEYOND THE CARBON PRICE

Even if we create appropriate emissions caps, carbon prices and offset markets, it won't be enough to temper climate change. Some needed improvements are destined to cost more than the likely near-term price of carbon. Even strategies in which cost is not an issue may be hindered by misaligned incentives, market failures, information gaps and the transaction cost of reaching millions of customers or firms. Our study and others have firmly concluded that a more robust carbon policy must be joined and supplemented with sector-specific policies that attack the perverse incentives, knowledge voids and non-price barriers that discourage individuals and organizations from making cost-effective energy improvements. These policies – together with carbon pricing – can create vibrant new markets for the cleanest technologies and attract the massive sums of private capital needed to transform the world economy. We now turn to those interventions in the power, industry, buildings, transportation and forestry sectors.

POWER



Power generation is the largest source of emissions and the sector with the highest global mitigation potential – 6 gigatons.

Production and use of electricity already accounts for two-fifths of greenhouse gas emissions; in the near future, growing power demands will force utilities, governments and others to invest a staggering sum of capital in energy projects – \$20 trillion by 2030, according to a recent International Energy Agency report.

No other energy investments are as menacing as those that fund coal-based energy. New coal-fired power plants – which are expected to meet the bulk of new demand if the status quo persists – will lock-in an unacceptable volume of emissions; they must be opposed at every turn. It will be a tough slog because coal is the cheapest, easiest and most widely used fuel for power generation in the U.S., China and India. All three nations have ample domestic supplies of coal that have become even more attractive due to energy security concerns.

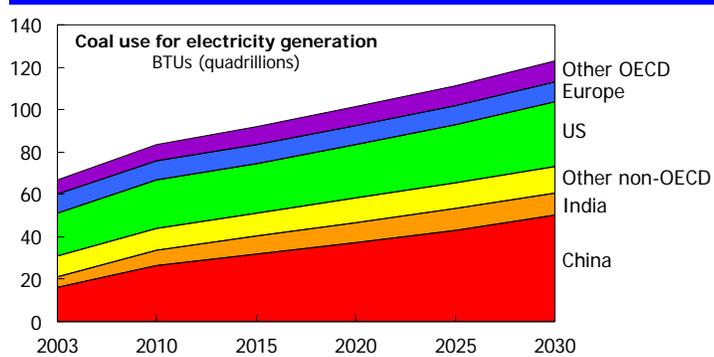
China’s use of coal is a paramount issue in the power sector, and a fundamental challenge for combating climate change. In one year, China adds enough power plants, nearly all of them coal-fired, to light the United Kingdom’s entire grid. Under business-as-usual assumptions, emissions from coal-fired generating stations in China will triple by 2030 – and swamp other efforts to limit greenhouse gases (Figure 11).

DETHRONING KING COAL

Coal may be the default option for electricity in many places around the planet, but its hegemony isn’t inevitable. Three strategies, outlined in Figure 12, will stop new coal plants from making global warming a *fait accompli*:

- **Minimize the need for coal-fired power plants** by encouraging upgrades in the productivity of existing coal plants with ultra/supercritical technologies and accelerating the

FIGURE 11: Projected Coal Use

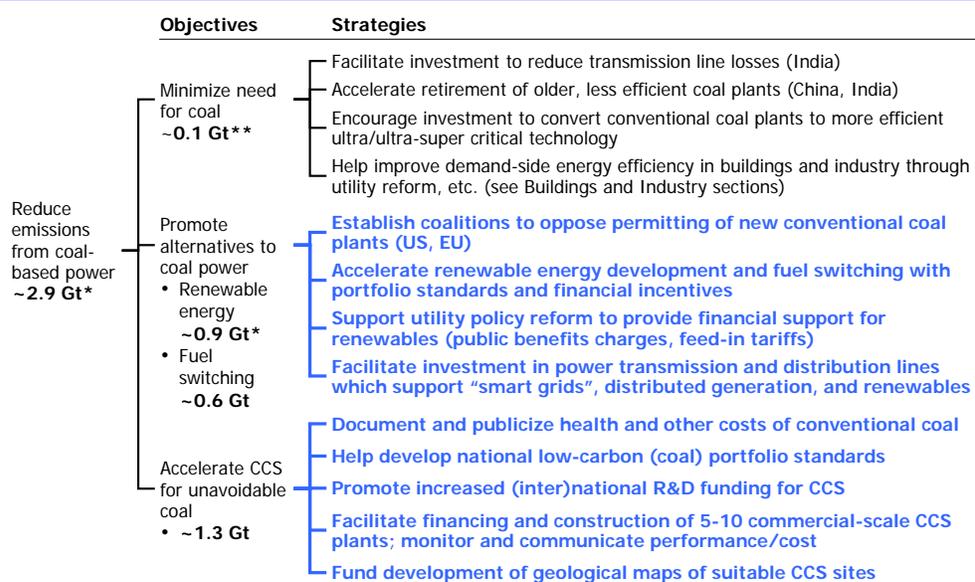


Source: Energy Information Administration International Energy Outlook 2006

retirement of older, less efficient plants. Reducing transmission line losses will also curb the demand for new coal-fired power. However, moving to ultra/supercritical is already a priority of governments around the globe and multi-lateral institutions like the World Bank, so little philanthropic assistance is needed. *Improving the energy efficiency of end-users to reduce demand for coal power is a higher priority and those strategies are described in the industry and building chapters that follow.*

- **Promote alternatives, such as wind and solar.** Philanthropy can support the transition to emissions-free power generation – even without considering the polarizing option of nuclear energy – by building coalitions to oppose new coal-fired plants and promoting utility reform that requires purchases of renewable energy and stepped-up efficiency. Aging transmission systems must be modernized and converted to “smart grids” so they can accept power from renewable sources that are decentralized. Wind, solar and other emissions-free sources are already at the top of politicians’ agendas and attracting large sums of private capital, but philanthropy can still play a pivotal role in advancing these technologies so they are adopted even more widely and quickly.
- **Reduce emissions from unavoidable coal** through carbon capture and sequestration (CCS). Even under the sunniest of scenarios, efficiency gains and expanded use of alternative energy sources won’t displace enough coal in the next two decades to forestall catastrophic climate change, so we must find a way to separate CO₂ emissions from coal plants and store them beneath the earth. CCS, which remains in its infancy, deserves a critical push from philanthropy so that it can be rapidly deployed where demand for coal power is the greatest.

FIGURE 12: Philanthropy Can Help Avoid Coal and Implement CCS (DTW Priorities Highlighted)



* Estimates likely conservative due to underestimation of gains from “clean-sheet” total system design

** Includes early retirements only; does not include ~3.7 Gt from demand-side efficiency counted under buildings and industry sector totals

Source: Mitigation potential adapted from IPCC, IEA, Vattenfall

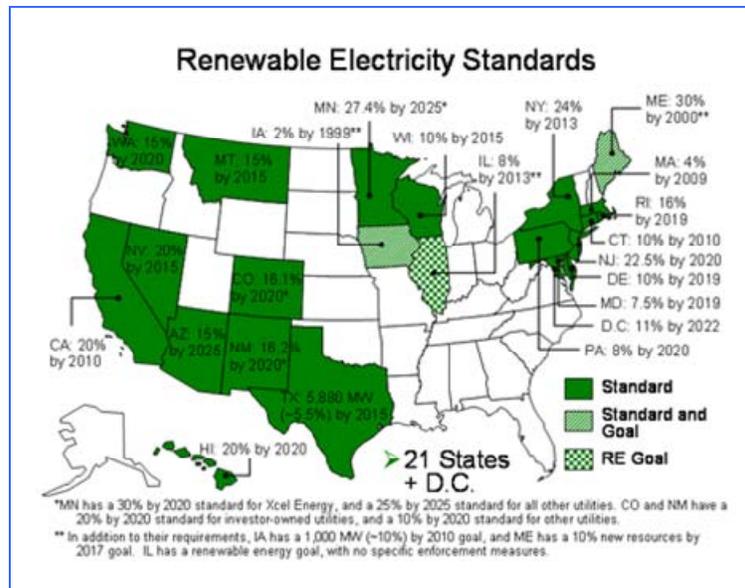
PHILANTHROPY MUST PROMOTE RENEWABLES AND LOW-EMISSION ALTERNATIVES

In an ideal world, renewable energy technologies would become sufficiently widespread and economical to obviate the need for any new coal-fired power plants. Philanthropists can move us toward that day by advocating for portfolio standards that require utilities to buy an increasing share of power from wind, solar and other emissions-free sources. In the U.S., 23 states have portfolio standards that could be expanded and perhaps consolidated into a federal program (see box below). In China, philanthropy can help the government deliver upon national renewable energy targets. Around the world, utilities should be given a financial incentive to improve energy conservation – not just sell electrons. If utilities’ revenues are “decoupled” from their sale of kilowatt-hours, they’ll be motivated to improve their ratepayers’ efficiency. When utilities are selling a service – and not just electricity – they’ll find that reducing energy demand is more profitable than building new power plants. With power providers and other businesses expressing growing interest in renewables, philanthropy has a golden opportunity to leverage private sector investments.

Our estimates of renewable energy’s mitigation potential are based on the best available data, but they should also be considered conservative. It is possible that future technological advancements and better integration of energy systems will allow renewables to reduce emissions even further. Still, even under the most optimistic of scenarios, renewables won’t be able to displace enough coal-fired power generation to avert warming of more than 2 degrees. As we discuss throughout this report, there is no cure-all for climate change – we must simultaneously attack the problem on a number of fronts.

CASE STUDY: U.S. RENEWABLE PORTFOLIO STANDARDS SAVED A HALF-GIGATON

A third of U.S. greenhouse gas emissions stem from electricity generated by utilities. One way to ensure more of that power is produced using renewable sources is to create portfolio standards that require utilities to buy electricity from wind, solar and other emissions-free sources. A \$23 million philanthropic investment supported efforts to enact renewable portfolio standards in 23 states. These new policies will forestall a half-gigaton of emissions by 2030 and spur some \$150 billion in private investment in renewable energy.



Source: Union of Concerned Scientists

PHILANTHROPY MUST ACCELERATE CCS

Renewable energy sources deserve continued, generous support from philanthropy, but available data suggests that by the time wind, solar and other technologies are up to sufficient scale, the battle against global warming could be lost if we haven't cleaned up the new coal plants that are bound to appear – especially in China and India. To avoid locking in emissions in the power sector, future coal-fired generating stations must be built to capture and sequester their greenhouse gas emissions.

CCS (described further in accompanying box) is already being used in a variety of industrial processes and several pilot projects have demonstrated the technology's promise for power production. But there is still a dearth of at-scale CCS plants in the energy sector. That has to change – and fast. Philanthropists must get CCS over the hump and make it practical for deployment in the U.S., China and India within the next decade.

How do we get there from here? For starters, a proper price on carbon would make CCS more financially attractive to utilities and spur more private investment in the field. But a carbon price alone will not cause CCS to scale up quickly enough to mitigate coal's climate impact. In the U.S., where companies worried about new regulations are actively pursuing CCS, philanthropists must support efforts to fast-track demonstration plants by ensuring that public policies and financial channels accelerate, rather than undermine, the technology's advancement. At the same time, donors and foundations need to help lay the groundwork in China and India so CCS can be rapidly adopted there once its feasibility is proven.

- **Fast-tracking CCS in the U.S.** Confronted with the prospect of a carbon price and emissions cap, U.S. utilities are keenly interested in reducing their regulatory exposure, so our efforts to promote CCS should begin in this country.

Philanthropists can help spur the industry if they advocate for standards that motivate utilities to build CCS systems. Pioneers must not be penalized for risk-taking. Policymakers can encourage other firms to follow suit by leveling the regulatory playing field with standards and clarifying legal frameworks. To more quickly address likely financial and regulatory barriers, philanthropists could support a high-level commission that unites utilities, banks, environmentalists, government agencies and carbon markets. Funding is needed for further research to identify the best sequestration techniques, determine appropriate locations for geologic storage and set benchmarks for evaluating the economic and environmental performance of the demonstration facilities. Philanthropy also needs to support public education campaigns that address the perceived safety risks of transporting and storing CO₂ near communities.

- **Developing local markets for CCS in China and India.** It won't be enough to get CCS plants up and running in the U.S. The technology must also

be adopted in the developing world, where demand for electricity is growing even faster. As CCS is proven in the U.S., we must simultaneously lay the foundation for CCS's development and deployment in China and India so that we can quickly head off the lock-in associated with new coal plants.

Philanthropists can help ensure that CCS technologies pioneered in the U.S. are applicable to other coal types and geological conditions by facilitating partnerships between U.S. businesses and their counterparts in China and India. Philanthropy can also advocate for increased government spending on advanced coal technology, mapping of potential sequestration sites, subsidies for demonstration projects and production/investment tax credits for private research and development in the field. By supporting research on the public health risks of coal-fired power generation, donors and foundations can build public and political support for alternatives in China and India.

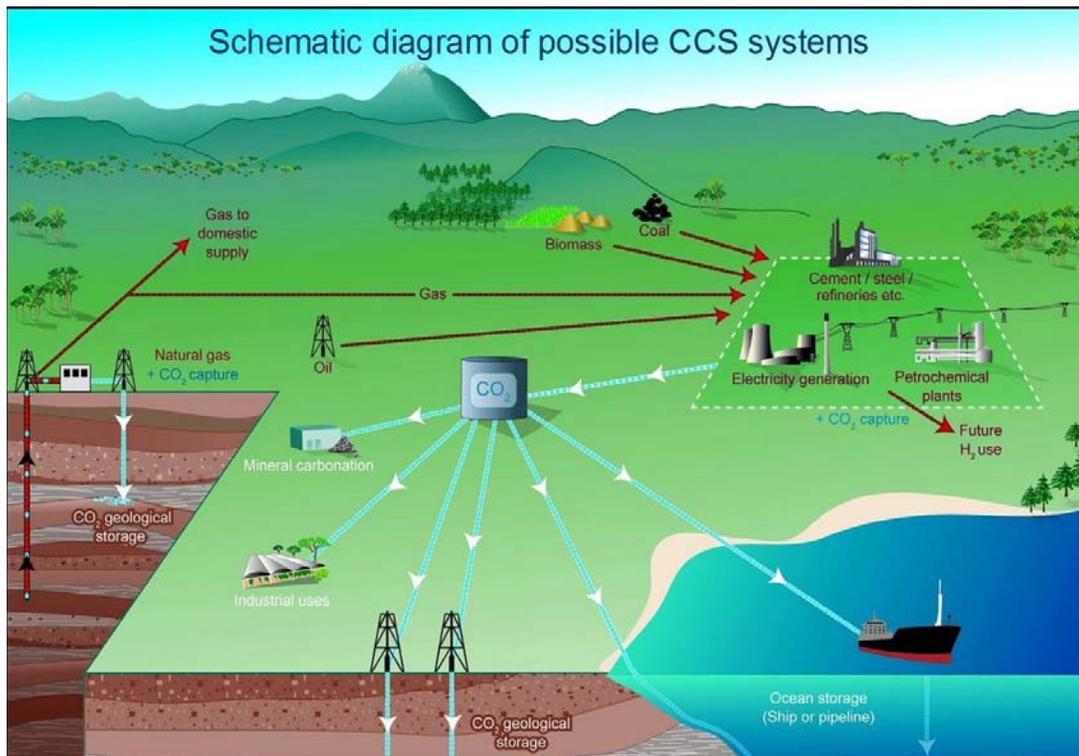
Greening our power generation will go a long ways toward stabilizing CO₂e levels at 450 ppm or below, but we must also strive to reduce the demand for electricity among end-users. We now turn to the efficiency improvements needed in two sectors responsible for the largest share of power demand – industry and buildings.

WHAT IS CCS?

Carbon capture and sequestration (CCS) is the process of separating CO₂ from industrial or power-generating sources and transporting it to a storage location where it can be isolated from the atmosphere. CCS would be applied to large, point-source emissions, such as power plants, and would likely use underground formations for long-term CO₂ storage.

It takes more energy (and money) to run a power plant equipped with CCS, but scientists believe the technology could capture 80 to 90 percent of a generating station's total CO₂ emissions. Several approaches – post-combustion, pre-combustion and oxyfuel combustion – are vying for dominance. This competition is healthy since varying coal qualities and geological conditions will demand a range of technologies. Experts envision that pipelines would transport the captured carbon (in the U.S., there are already more than 1,500 miles of CO₂ pipelines). Storage of CO₂ would use many of the same techniques currently employed in oil and gas extraction; in fact, pumping CO₂ into oil and gas fields could force additional hydrocarbons to the surface.

A recent MIT study on the future of coal concluded that CCS “is the critical enabling technology that would reduce CO₂ emissions significantly while also allowing coal to meet the world's pressing energy needs.”



Sources: Intergovernmental Panel on Climate Change; *The Future of Coal: Options for a Carbon-Constrained World* (MIT, 2007)

INDUSTRY



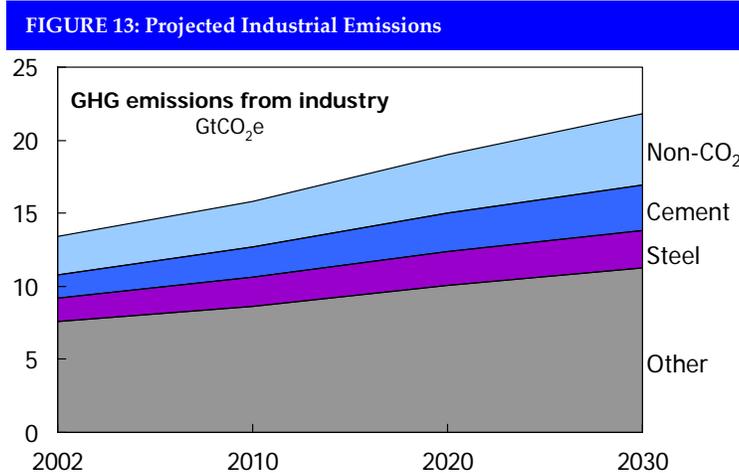
The smokestacks that rise above steel mills, cement plants and other factories – and the power plants that fuel them – emit more greenhouse gases than any other sector.

By 2030, business-as-usual models predict a 60 percent increase in emissions (Figure 13). The industrial sector threatens to cause both direct and indirect lock-in of new emissions sources. A factory is built to last, so an inefficient design will saddle the atmosphere with more carbon for decades to come; at the same time, one-third of industrial emissions stem from purchased electricity, so the sector can exacerbate “upstream” lock-in by boosting the demand for coal-fired power plants.

A CHALLENGING SECTOR THAT NEEDS A PUSH

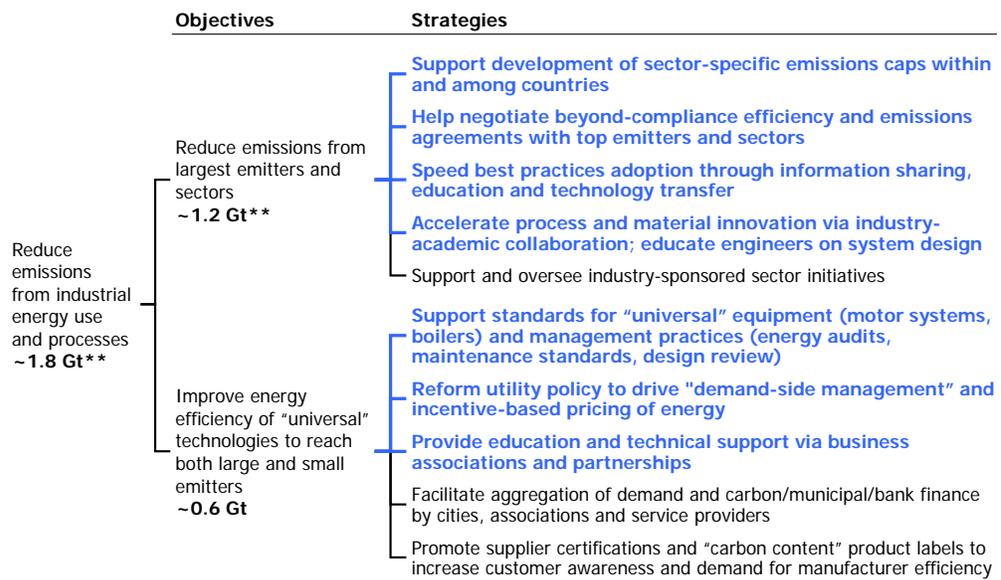
Getting industry to become more efficient and less carbon-intensive is no easy task. While there are some win-win opportunities where businesses can reduce both their emissions and energy bills, in many cases the efficiency improvements cannot be justified on cost savings alone. Some analysts believe that half of the possible interventions in the industrial sector will still cost more per ton of avoided emissions than the likely near-term price of carbon.

Philanthropic intervention is especially needed in this sector because industrial emissions are projected to reach 20 gigatons by 2030 – about one-third the global total under business-as-usual assumptions. The high price of improving industrial efficiency and the need for step-changes in technology pose serious challenges for mitigation, yet experts have identified actions that will reduce the sector’s CO₂e output by 4 gigatons globally.



Source: Adapted from Vattenfall

FIGURE 14: Philanthropy’s Role in Industry (DTW Priorities Highlighted)



* Estimates likely conservative due to underestimation of gains from “clean-sheet” total system design

** Does not include CCS or non-CO₂ mitigation options

Source: Mitigation potential adapted from IPCC, USEPA, Vattenfall

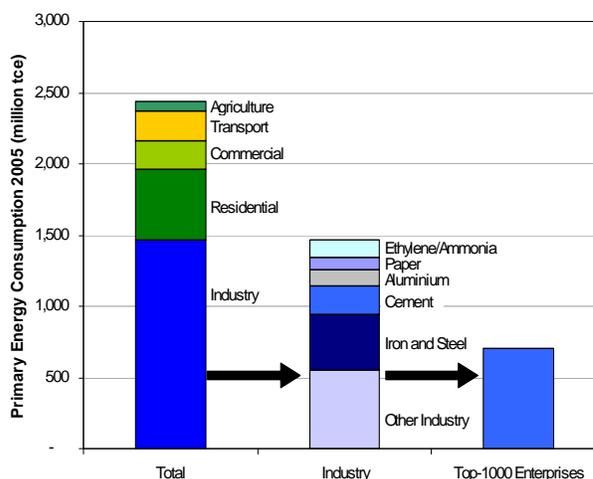
Besides confronting steep costs and technological barriers, efficiency improvements in the industrial sector must overcome other formidable obstacles. Businesses face daunting information costs as they search for new production techniques. Individual companies have little incentive to be first movers in an industry and struggle to ascend the learning curve, only to watch their competitors profit from their knowledge. Even in industries where technical know-how is not an issue, factory owners may earn a higher rate of return by investing their marginal dollar in non-efficiency projects, such as increasing capacity. Plant managers generally aren’t rewarded for energy improvements. And utilities are typically set up so that efficiency gains reduce the demand for their product – electricity – and therefore hurt their financial bottom line.

To slash industrial emissions, philanthropy should promote new standards and utility reforms that will motivate firms to design long-lived assets with energy in mind (Figure 14). Innovative financing mechanisms, such as efficiency loans, can bolster efforts to reduce industrial emissions, but philanthropy should focus on advocating for better policies, which in turn will steer capital toward cleaner technologies. For all the challenges of working with industrial emitters, the sector also affords some advantages: many firms have large sums of money at their disposal and a financial incentive to cut their energy use. Donors and foundations can help nudge these industrial emitters toward a less carbon-intensive future. In other instances, strategies can target the “universal” equipment that is common in most mid-market companies.

CASE STUDY: STANDARDS AND AGREEMENTS SLASH EMISSIONS FROM CHINA'S TOP-1000 INDUSTRIAL FIRMS

Philanthropy is helping keep a half-gigaton of emissions out of the atmosphere by developing standards for universal equipment and facilitating efficiency agreements between Chinese factories and the government. By working with heavy industry – which is responsible for two-thirds of China's energy use and emissions – philanthropy has been able to mitigate 507 tons of CO₂ emissions per dollar invested.

Primary Energy Consumption of China's Top-1000 Enterprises



Source: Energy Foundation, based on Jiang et al., 2007 (1 tce = 29.7 GJ = 27.8 MBtu)

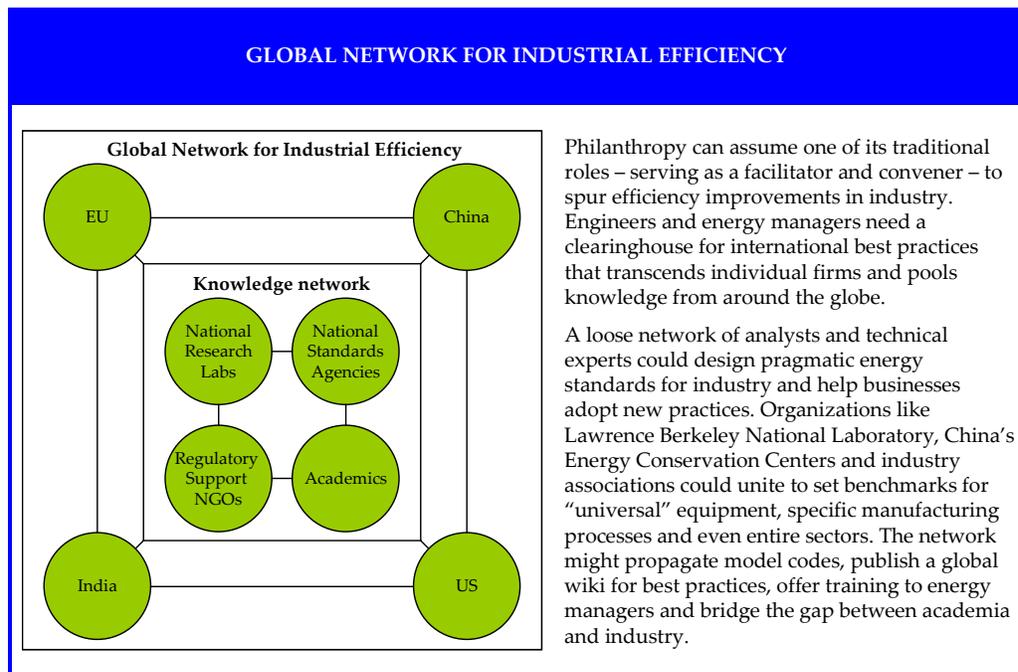
PHILANTHROPIC STRATEGY STRUCTURED BY FIRM SIZE

Raising industry's energy efficiency requires a three-pronged approach that accounts for the diversity of players in the sector:

- **Engage big emitters.** A limited number of big companies in the top emitting industries, such as steel, cement, aluminum and petrochemicals, account for a large share of total emissions. Just in our target countries, these firms' output can be reduced by 1.2 gigatons. Because these businesses consume a considerable amount of energy, they are interested in improving the efficiency of their production processes. Philanthropy can spur these industries further by advocating for sector-specific emissions standards and voluntary beyond-compliance agreements (one example is the China Top-1000 Enterprises case study discussed above). To help companies comply with pragmatic emissions caps, donors and foundations can expedite the transfer of expertise. A new global network of industrial efficiency specialists could help bridge the knowledge gaps and spread best practices (see Global Network box, next page).
- **Improve codes for "universal" equipment.** It's impractical to develop company-specific solutions for the millions of mid-market operations that produce the balance of industrial emissions. But we can still reach this

eclectic group of firms by adopting efficiency standards for the motors, pumps, boilers and other run-of-the-mill technology systems found in most factories. Scaling back the power consumption of individual pieces of equipment is not enough – a systems approach that examines how the individual machines fit together can deliver even greater efficiency gains. Management standards that require energy audits will reveal inefficiencies and help manufacturers ensure their entire system’s performance is optimal. The carbon output of universal equipment systems is astonishing – in our target countries alone, it can be cut by 0.6 gigatons per year.

- **Promote utility reform.** Utility reform, critical to reducing emissions in the power sector, is just as important for cutting industry’s energy use. Through their customer base, utilities naturally aggregate smaller factories, so they provide another convenient access point for reaching mid-market businesses. In the U.S., foundations can advocate for public benefits charges and feed-in tariffs that earmark a portion of utility revenues for efficiency upgrades and investments. Existing utility reform efforts in Guangdong, China and Maharashtra, India are worthy of replication, as are China’s Energy Conservation Centers.



BUILDINGS



We already know how to dramatically improve the energy efficiency of all manner of buildings and appliances; in many cases, the improvements pay for themselves in a matter of years (Figure 15). Unfortunately, the sector’s mitigation potential has yet to be realized. What’s standing in the way are some classic principal-agent problems: developers must pay extra to make buildings more efficient, but it’s the occupants who reap the savings; similarly, landlords have little incentive to buy more efficient refrigerators or air conditioners if their renters foot the electric bill.

The building sector – which accounts for nearly a fourth of 2030 emissions and offers 4 gigatons of mitigation potential – faces major lock-in challenges: the carbon footprint of a new office complex or high-rise apartment building may persist for more than a half-century, while inefficient designs only boost the demand for coal power (three-fifths of the sector’s emissions stem from purchased electricity). As a result, our priority in this sector is to ensure that new buildings – and the appliances within them – meet ambitious efficiency standards.

Philanthropy can address the mitigation potential in existing buildings by helping accelerate retrofits and appliance turnover, largely through appliance standards and utility reform (Figure 16). Progressive financing schemes, such as efficiency mortgages, can also help make buildings greener, but as with the industrial sector, philanthropists should focus first on promoting the codes and standards that will reinforce the demand for such financial instruments.

FIGURE 15: Building Emissions Abatement Opportunities Available at Cost Savings

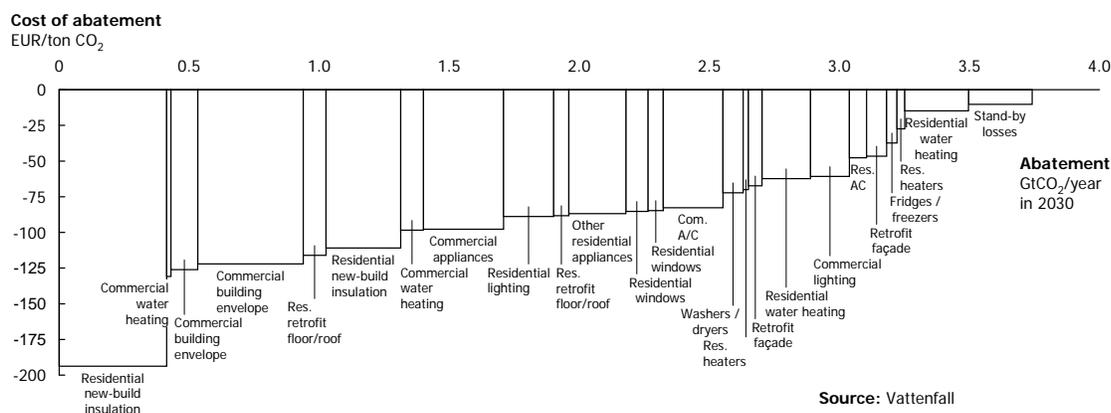
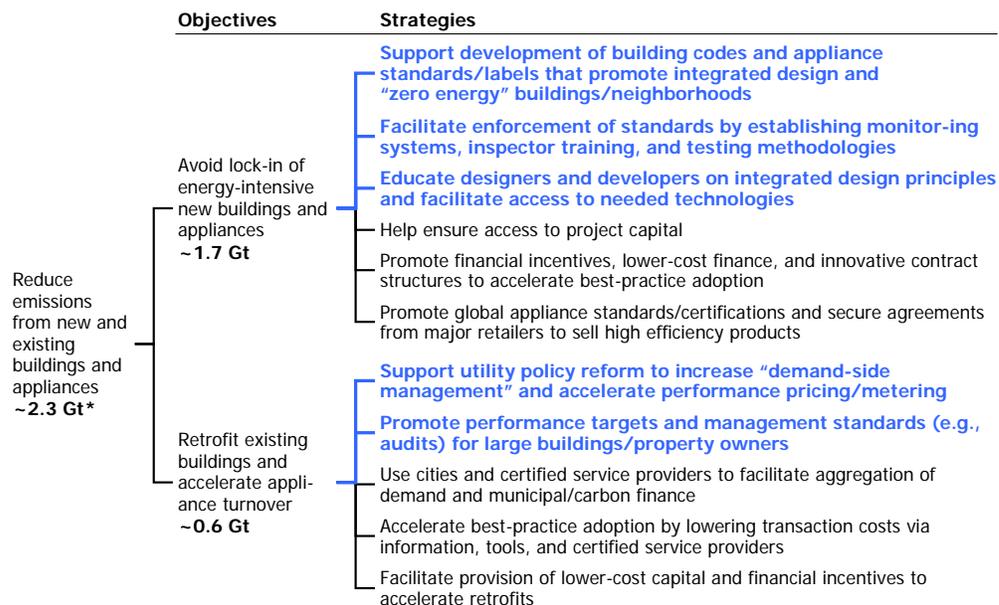


FIGURE 16: Philanthropy’s Role in Buildings (DTW Priorities Highlighted)



* Estimates likely conservative due to underestimation of gains from “clean-sheet” total system design
 Source: Mitigation potential adapted from IPCC, USEPA, Vattenfall

SPLITTING THE SECTOR INTO NEW AND OLD

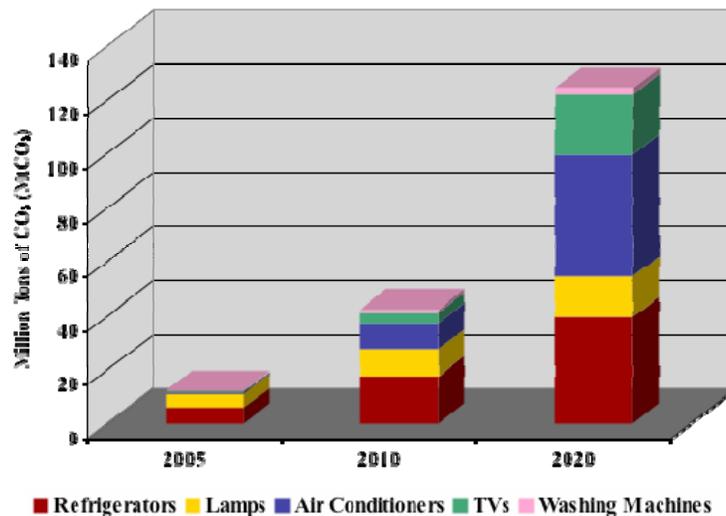
To design interventions in the building sector we divided the world into the new and old:

- NEW: Standards guide future building.** The biggest mitigation potential in the sector – about three-fourths of the total – lies with commercial and residential properties that have yet to materialize. Stronger building codes and appliance standards can ensure these new structures are energy efficient. Philanthropists can support efforts to design and propagate codes that will influence a builder’s choice of location, materials, insulation, windows and climate control equipment. Philanthropy can also help create an international network of local institutions (see accompanying box) that promotes enforcement strategies and best practices, such as the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) Green Building Rating System. The emphasis should be on performance-based standards, either at the state or national level, which set targets and then allow builders, rather than bureaucrats, to choose the most effective means for achieving efficiency gains. With appliances, if a select number of major importing countries adopt efficiency codes, manufacturers around the world will be forced to reengineer their products.

**CASE STUDY: CHINESE APPLIANCE STANDARDS MITIGATE
120 MILLION METRIC TONS OF EMISSIONS**

China, the world's top maker of household appliances, is rapidly becoming a leading consumer of those products. Refrigerators, a rarity in China in 1980, are now found in more than 90 percent of homes. A \$3.5 million philanthropic investment helped Chinese experts develop appliance standards that will cut the nation's residential demand for electricity by 10 percent and obviate the need to build 36 large (1,000 MW) coal-fired power plants.

Energy Savings From Appliance Standards



Source: Energy Foundation

- **OLD: Utility reform accelerates upgrades.** Although the majority of mitigation potential in the building sector rests with new construction and appliances, we can't ignore what's already out in the market. Steep transaction costs preclude philanthropy from directly engaging millions of consumers and companies, but utilities serve as natural access points since they have existing relationships with these end-users of power. Decoupling profits from revenue and enacting portfolio standards that require efficiency improvements will encourage utilities to meet growing energy demands by stepping up the pace of building retrofits and appliance turnover. Utilities can offer rebates, bolster energy audit programs and further promote conservation by adopting time-of-use schedules and tiered rate structures that charge customers more per kilowatt-hour during peak times or beyond certain benchmarks.



From Manhattan to Shanghai, new offices and apartment buildings are being designed and built to exacting efficiency standards. These projects show the tremendous potential for mitigation in both commercial and residential properties, but the spotty nature of progress also reminds us of the work to be done. Architects and engineers already know how to drastically reduce energy use in the buildings where we live, work and shop – the challenge is spreading knowledge across the globe. A collection of experts and institutions could help create and implement new codes and standards for buildings and appliances. In addition to disseminating international best practices, this organization could educate consumers, advocate for utility reform, improve enforcement and convene training workshops.

TRANSPORTATION



As car-centric cities continue to expand in the U.S. and dreams of vehicle-ownership are realized in the developing world, millions of new cars are hitting the roads each year.

By 2030, the number of autos in China is projected to quintuple to 150 million; in India, a thirteen-fold increase is expected (Figure 17).

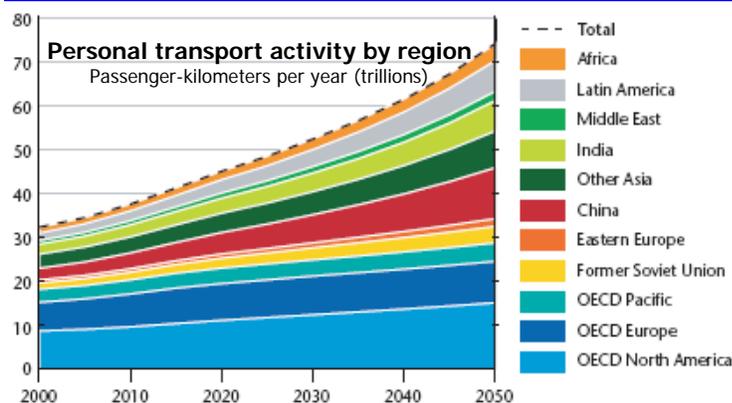
The specter of lock-in also haunts the transportation sector, though perhaps not in the obvious way it does with the power, buildings and industry sectors. Individual cars, pickups, SUVs and other “light-duty” vehicles – which account for half the sector’s emissions – only last so long, but production methods are slow to change, as evidenced by the continued dominance of the internal combustion engine a century after it was invented. Even more troubling is the permanence of urban planning decisions that solidify the car’s ascendancy. When a city neglects its mass transit and decides to grow out – not up – residents’ dependence on the auto and soaring emissions may be preordained.

PHILANTHROPY MUST ADDRESS EFFICIENCY, FUELS AND VEHICLE TRAVEL

Halting the automobile’s proliferation is a losing battle because demand is so pent-up and inelastic. But philanthropists can support three strategies to minimize vehicle emissions and forestall 3 gigatons of greenhouse gas emissions, as shown in Figure 18.

- **Improve vehicle efficiency.** If we can’t stop people from buying cars, we can at least make new vehicles go farther on less gas. As with buildings and appliances, standards will be the key catalyst that spurs a revolution in design. The U.S., E.U. and China must take the lead since they are home to major automakers and will account for half of global

FIGURE 17: Transportation Activity by Region

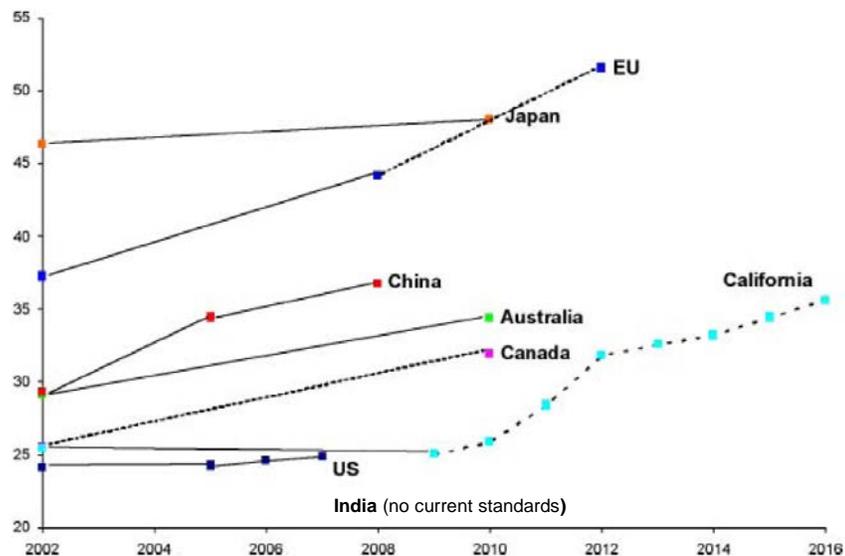


Source: WBCSD Sustainable Mobility Project

vehicle sales by 2050, but proactive programs are also needed in India. Proposed efficiency rules in California and the E.U. are promising. China must continue to ratchet up its standards, even in the face of growing opposition from automakers; India is just beginning to develop its own mileage policy. In both China and India, a modest philanthropic investment could keep a significant amount of CO₂ out of the atmosphere.

CASE STUDY: PHILANTHROPY HELPS CHINA ADOPT ITS FIRST MILEAGE STANDARDS

A recent philanthropic investment of about \$1 million helped create new standards for cars and light trucks in China that will reduce emissions by a quarter-gigaton. Such impressive returns – equivalent to 314 tons of CO₂ per dollar – were achieved by funding a review of best practices and facilitating regular communication among researchers, decision-makers and international experts on policy design.



Source: Pew Center on Global Climate Change

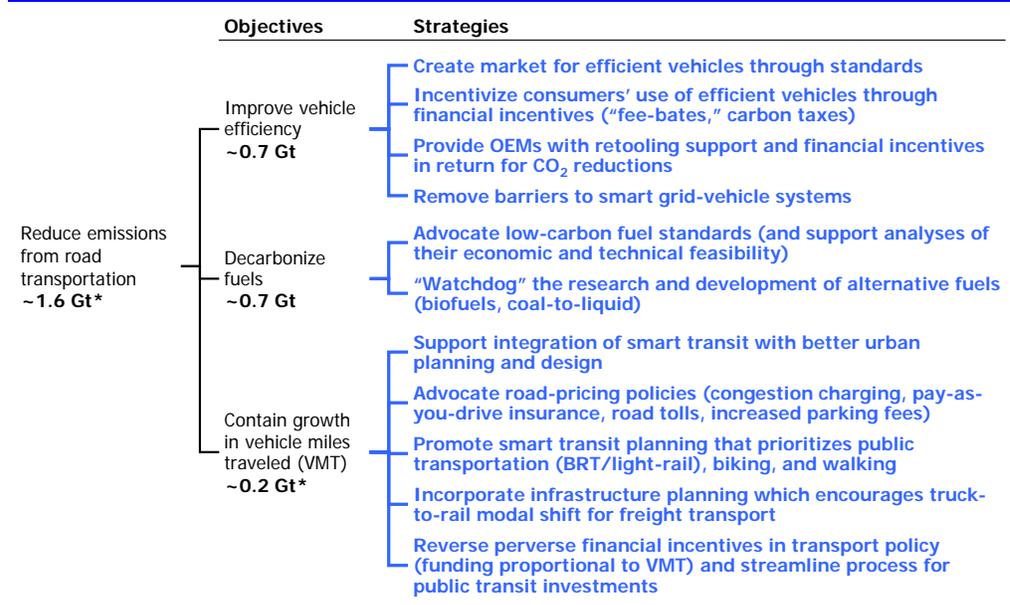
Philanthropists also must prod the biggest laggard – the U.S. – toward more stringent mileage standards by building on aggressive state-level efforts, uniting unlikely allies and supporting the policy analyses needed to forge a “grand bargain” among Washington, Detroit, Wall Street and Main Street. With opposition from automakers growing along with the threat of stricter standards, philanthropy can help broker a compromise. This may require government

assistance for retooling auto plants and easing car companies’ crushing pension and health care burdens.

- **De-carbonize vehicle fuels.** As vehicles become more efficient, they should also run on fuels that generate less carbon emissions. Geopolitical worries in the U.S., E.U. and China have already hastened the search for substitutes for petroleum, but some of the alternatives, such as the wrong kind of biofuels and coal-to-liquid, may actually make global warming worse because their production is so carbon-intensive. Philanthropists can help ensure that alternative fuel standards not only reduce dependence on foreign oil but are also low-carbon standards that reduce greenhouse gas emissions. Donors and foundations can help fund research on the lifecycles of the various fuel blends, explain the tradeoffs to the public, translate findings for policymakers and develop pragmatic implementation schedules.

- **Reduce vehicle use.** Even if our cars are more efficient and our fuels are cleaner, any emissions reductions could be more than offset by the skyrocketing number of vehicles on the world’s roadways. We must reduce vehicle use and, in essence, get people to keep their cars parked more often. Urban planning that causes city residents to depend on private vehicles – rather than bikes, buses, trains or their own two feet – amounts to a critical lock-in of carbon. Foundations can confront this threat by promoting progressive urban planning and transportation policies that put a premium on curbing emissions, including: mixed-use developments that co-locate homes, offices and shops; parking and congestion fees that discourage driving; more pedestrian-friendly cityscapes that encourage walking; and dedicated lanes for bikes and three-wheeled vehicles,

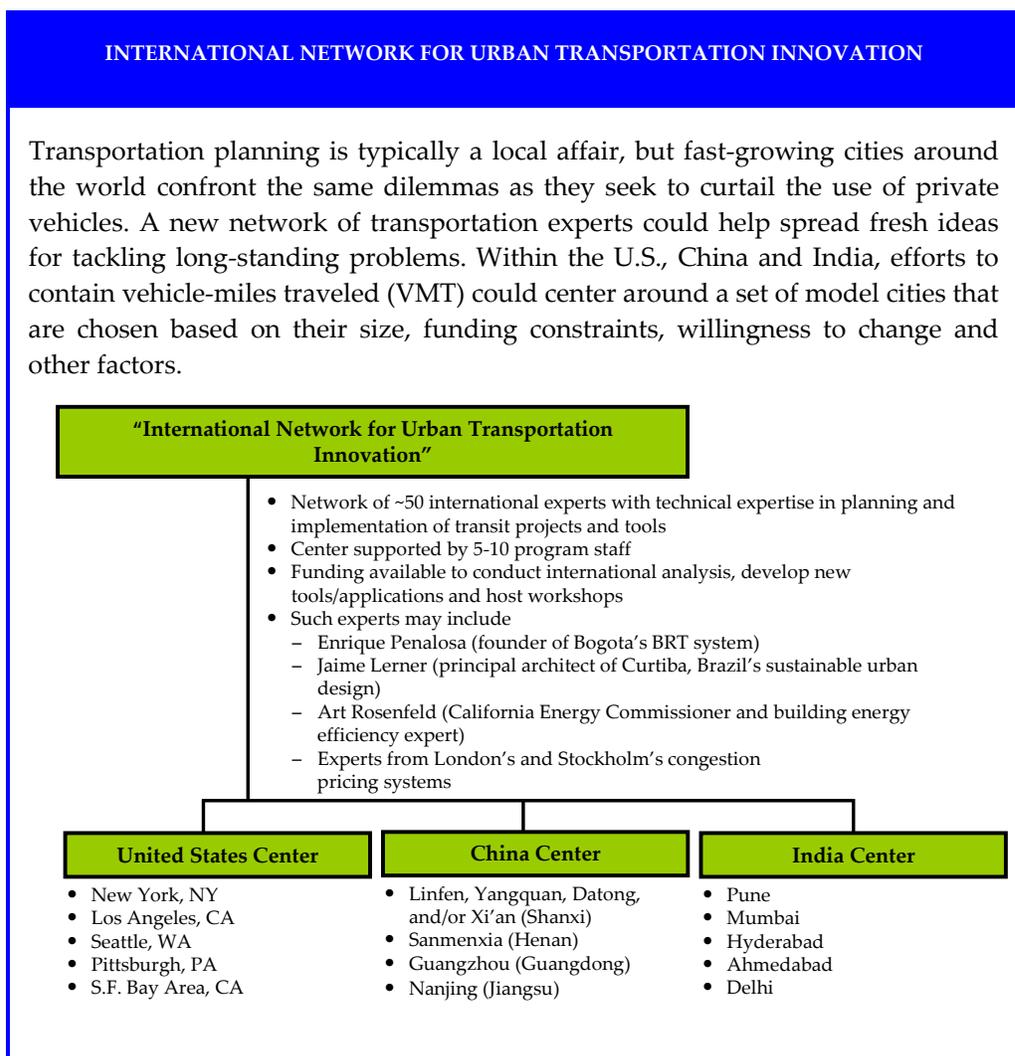
FIGURE 18: Philanthropy’s Role in Transportation (DTW Priorities Highlighted)



*Estimates likely conservative due to underestimation of gains from “clean-sheet” total system design
Source: Mitigation potential adapted from IPCC, USEPA, Vattenfall

especially in the developing world where these common modes of transport must persist.

An international network of experts (see accompanying box) could advance these strategies and spread best practices in the transportation field, such as London’s congestion-pricing and Bogotá’s TransMilenio bus-rapid transit system, which offers a cheaper, more flexible alternative to light rail. Philanthropy can also back efforts to restructure the financing of public infrastructure to support transportation-oriented development and smart transit. In the U.S., the next federal transportation bill presents a critical opportunity to influence planning decisions for years to come.



FORESTRY



Forests, especially those around the equator, play a pivotal role in climate change because they absorb CO₂ from the atmosphere during photosynthesis. When a jungle is cleared for farming, grazing or development, the biosphere loses yet another vital “sink” where carbon is sequestered. To add insult to injury, burning down a tropical forest liberates the carbon stored in the plants. If current trends continue, the world will have lost another 100 million hectares of tropical forest by 2030. Because deforestation is now at peak levels, every year we delay action shrinks the sector’s mitigation potential (Figure 19). Avoiding deforestation is so important that its mitigation potential – about 2 gigatons – equals that of CCS.

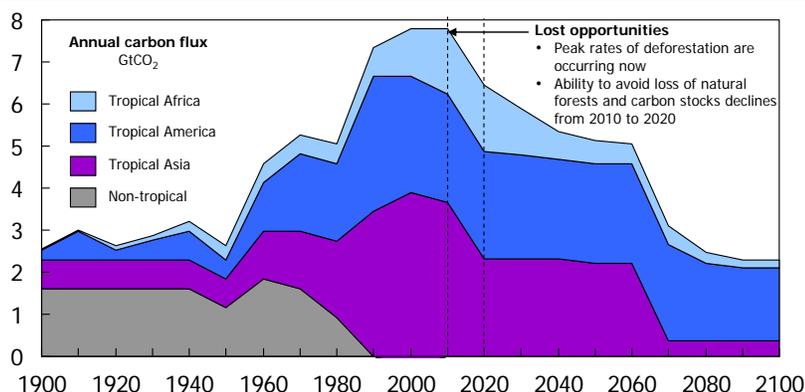
While it’s possible to restore degraded or denuded forests, lock-in concerns dictate a focus on avoiding deforestation in the first place – just as our priority in the buildings sector was to improve the efficiency of new construction, rather than retrofit existing buildings.

Three regions – the Amazon, Congo and Indonesia – offer the greatest potential to reduce the loss of vital carbon sinks. Our efforts to curb deforestation in each area must account for varying local conditions. In Indonesia, for instance, demand for timber and palm oil are the main drivers of forest loss, while in the Congo, poverty and unclear land ownership lead to slash-and-burn agriculture and logging for fuel wood. In the Amazon, there are some glimmers of hope: in 2005, deforestation there fell 30 percent due to government interventions and falling prices for soy, which is often planted in place of tropical trees.

NEW FUNDING FOR AN ONGOING STRUGGLE

Because the tropics are such hotspots of biodiversity, conservationists have been attacking the drivers of deforestation for many years. The urgency of climate change may be what finally sparks a breakthrough. Putting a price on carbon and creating a market for offsetting emissions could generate a large pool of money to protect tropical forests. If properly structured, this carbon-financed

FIGURE 19: Delaying Action Will Lead to Greater Loss of Forest Carbon Sinks



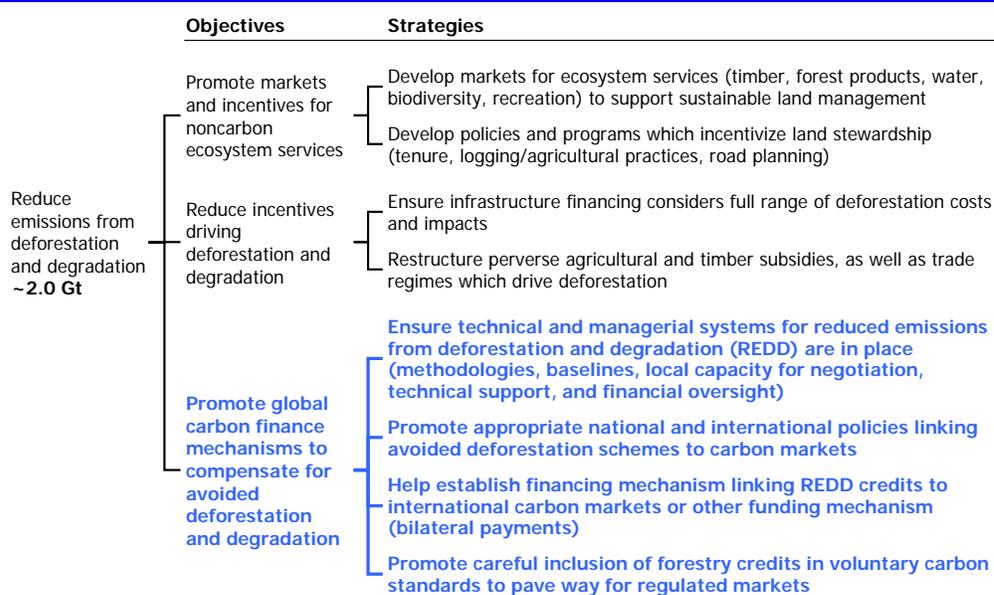
Source: Adapted from Vattenfall, Houghton

market could give local residents an incentive to leave trees standing and bolster long-standing efforts to clarify land tenure, improve stewardship and remove perverse subsidies.

A number of strategies for reducing deforestation, such as establishing and financing protected areas and compensating landowners for improved forest management, continue to attract considerable interest from the environmental community and local NGOs (Figure 20). These campaigns, while essential and promising, haven't been brought up to scale because funding has been inconsistent and inadequate. Now, carbon markets promise to inject new resources into these enduring efforts to keep tropical forests intact.

So far, avoided deforestation has not been included in offset markets, in part because of the challenge of measuring and monitoring land use in some of the world's least developed regions. But advances in satellite imagery and other remote-sensing technology – plus the urgency surrounding climate change and the growing recognition that avoided deforestation must be part of the equation – have made this financing mechanism a likely addition to the next round of international carbon policy. In anticipation of this influx of funding, we must create pilot projects and monitor the results to learn how to best structure compensation systems.

FIGURE 20: Philanthropy's Role in Avoiding Deforestation (DTW Priorities Highlighted)



Source: Mitigation potential adapted from IPCC, USEPA, Vattenfall

LINKING TROPICAL FORESTS TO CARBON MARKETS

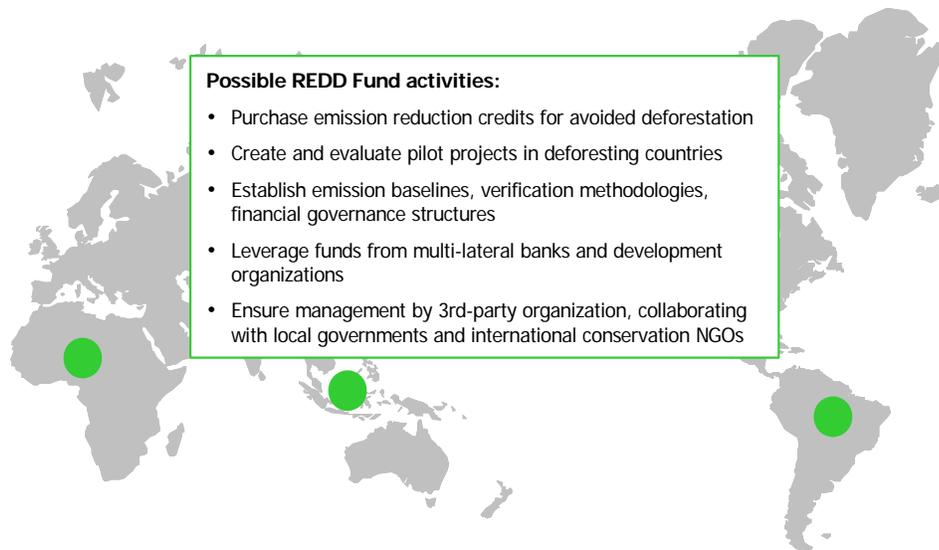
In the Amazon, Congo and Indonesia, philanthropists can use carbon finance to help forestall deforestation by:

- **Laying the groundwork for compensation.** The dynamic nature of forests makes them difficult to measure and monitor, but such capacities are precisely what's needed to make compensation systems efficient, equitable and effective. Scientists must inventory tropical forests and establish carbon baselines. Land managers must continually evaluate local conditions to ensure forest integrity. Banks must create transparent financial mechanisms for receiving compensation and fairly distributing payments.
- **Ensuring carbon markets include deforestation.** U.S. climate legislation, post-Kyoto treaties and voluntary efforts to reduce greenhouse gases must clarify that avoided deforestation qualifies as an offset – something missing from previous efforts – and devote significant resources to the program. Because credits from avoided deforestation will be less expensive than others, tighter and broader emissions caps are needed to prevent “cheap” credits from undermining carbon markets.
- **Linking carbon markets and deforestation.** Based on the science, monitoring, policy prescriptions and lessons from pilot projects, we must facilitate the flow of international capital to the residents, land managers and government agencies that protect forests. Chronic problems with land tenure and local governance structures must be overcome.

Fortunately, multilateral institutions are already working to establish a fund that would address these issues (see accompanying box). Philanthropy can supplement the activities of such a fund by supporting additional pilot projects.

INTERNATIONAL REDD FUND

A large-scale fund to support reduced emissions from deforestation and degradation (REDD) could help demonstrate the feasibility of using emissions markets to prevent the loss of carbon sinks in the tropics. This fund is currently being negotiated by multilateral institutions and would potentially be overseen by neutral, third-party observers. It could design and implement pilot projects that include credible baselines, rigorous monitoring, transparent financial transactions and inclusive decision-making.



PHILANTHROPIC INVESTMENT NEEDED



There may not be a silver bullet solution available, but there is a silver lining. Never before have people around the world been so attuned to climate issues, energy policy and the impact of their everyday decisions on the planet’s future. Seeking to get out in front of looming regulations, energy producers and auto makers who were once leading skeptics of climate change are now taking pains to shrink their businesses’ carbon footprint. At home and abroad, philanthropists determined to address global warming will find the public and politicians increasingly receptive to fresh ideas that are both ambitious and astute.

Our analysis, which sought to prioritize the strategies available to foundations, produced the somewhat surprising – and encouraging – finding that a limited set of philanthropic interventions can have a profound impact on global carbon output. The initiatives highlighted in this analysis could eliminate 11 gigatons of CO₂e emissions by 2030 and carry the world a third of the way toward our ultimate goal: an atmosphere in which CO₂e concentrations don’t exceed 450 ppm and temperatures don’t rise than more 2 degrees (Figure 21).

FIGURE 21: DTW Interventions Address ~ 11Gt Mitigation Potential

Strategies	Mitigation potential GtCO ₂ e		ESTIMATED Annual philanthropic investment NEEDED (\$ Millions)	Annual philanthropic investment CURRENT (\$ Millions)	
	Global	DTW			
Power	Minimize need for coal	0.1*	0.1*	\$5-10*	\$15.1
	Promote alternatives to coal power	2.3	1.5	\$40-50	\$28.1
	Accelerate CCS for unavoidable coal	2.0	1.3	\$30-40	\$0.0
Industry	Reduce emissions from largest emitters and sectors	1.8	1.2	\$80-90	\$2.6
	Improve efficiency of “universal” equipment to reach both large and small emitters	1.2	0.6	\$50-60	
Buildings	Avoid lock-in of energy-intensive new buildings and appliances	3.0	1.7	\$90-100	\$10.3
	Retrofit existing buildings and accelerate appliance turnover	1.0	0.6	\$30-40	\$29.0
Transport	Improve vehicle efficiency	1.3	0.7	\$30-40	\$19.8
	Decarbonize fuels	1.2	0.7	\$30-40	
	Contain growth in vehicle miles traveled (VMT)	0.3	0.2	\$40-50	
Forestry	Promote local markets and incentives for non-carbon ecosystem services	2.0	2.0	\$10-20	\$6.0
	Reduce incentives driving deforestation				
	Promote global carbon finance mechanisms to compensate for avoided deforestation and degradation				
Policy	Ensure adoption of aggressive, well-designed carbon policy			\$60-70	\$60.3
	Establish prerequisites for implementation of carbon policy			\$20-30	
	Expand funding for and cooperation on key technologies			\$10-20	
		~ 16 Gt	~ 11 Gt	\$525-660	\$176.6

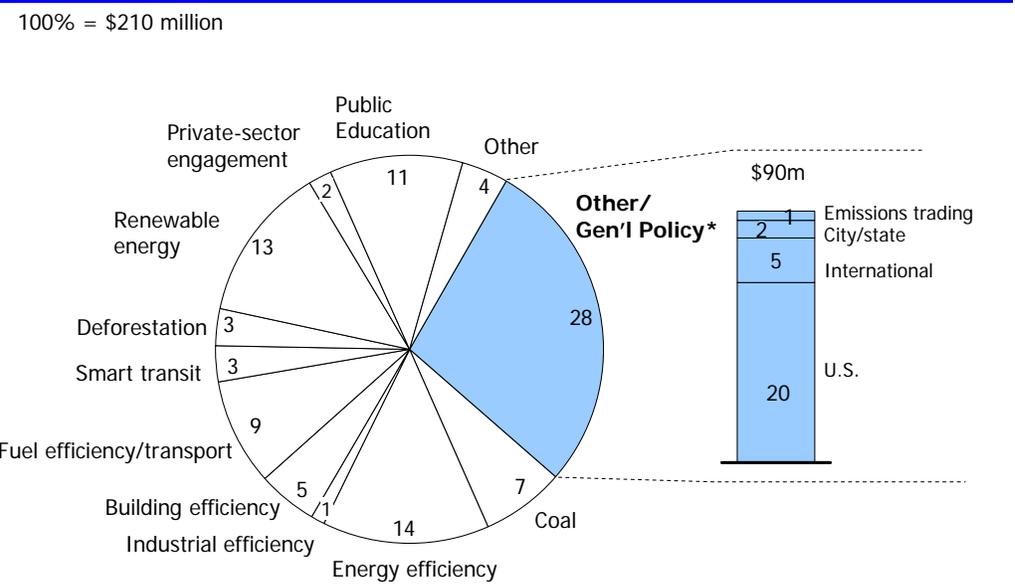
*Only includes accelerated retirement; does not include 3.7 Gt from demand-side efficiency counted under buildings and industry
Source: Mitigation potential adapted from IPCC, USEPA, Vattenfall

In addition, our analysis estimated philanthropic funding currently dedicated to climate change and the relative magnitude of additional resources needed. To locate gaps in current philanthropic funding of climate change programs, we interviewed officials from 28 foundations that describe themselves as active in the issue. In total, philanthropy is now devoting about \$210 million annually toward the fight against global warming.⁴ By comparison, U.S. philanthropy devoted \$3.2 billion to health, \$3.1 billion to education and \$1.5 billion to the arts in 2004, according to the Giving USA Foundation.

Figure 22 breaks down climate-related spending by sector and shows that some areas, such as industrial efficiency and smart transit programs, receive scant funding. It's important to note, however, that our philanthropic survey was biased toward U.S. foundations and therefore not necessarily representative of the global total. Likewise, organizations that work to reduce tropical deforestation or other drivers of climate change were not included in our analysis if their programs were not specifically geared toward mitigating global warming.

During our interviews with experts and activists in the field, we asked about the relative magnitude of existing climate change efforts and the additional capacity needed. Based on this input and our survey of current philanthropic expenditures, we estimate that additional funding of approximately \$600 million is needed annually to implement the Design to Win priorities.

FIGURE 22: Current Philanthropic Funding By Sector



* Includes funding explicitly allocated for general policy activities and policy-related activities which funders could not allocate to specific sectors or initiatives.

⁴ This figure is larger than the \$176.6 million total in Figure 21 because some philanthropic spending on climate change is not devoted to Design to Win strategies.

A comparison of existing funding allocations and our recommended priorities revealed major gaps within the philanthropic sector that should be attended to. These include:

- Carbon policy advocacy and supportive analysis in the U.S. and around the globe
- Sustained investment to build vibrant markets for renewables to replace coal, particularly in China and India
- CCS deployment to mitigate emissions from coal-fired power plants, particularly in the U.S., China, and India
- Influencing the built environment: energy efficiency of buildings and appliances, development patterns, and transportation infrastructure
- Emissions mitigation in the industrial sector, particularly in the U.S., China, and India
- Greater support for strategy implementation in India, where efforts are underway but with little private, philanthropic backing

By itself, an additional annual investment of \$600 million dollars won't be enough to prevent global warming from becoming a planetary disaster, but it could inspire the step-changes in technology that complete the journey.

NEXT STEPS



As philanthropists ponder how to confront the challenge of the century, they must select wisely from a wide menu of options.

Our prioritization of the strategies available to donors and foundations yielded a select number of interventions that can catalyze the global economy and significantly reduce greenhouse gas emissions.

Transitioning to a low-carbon economy will demand the use of a diverse set of tools. Foundations must invest in every stage of this progression – from policy development and advocacy, to public and media education, to the implementation of international best practices.

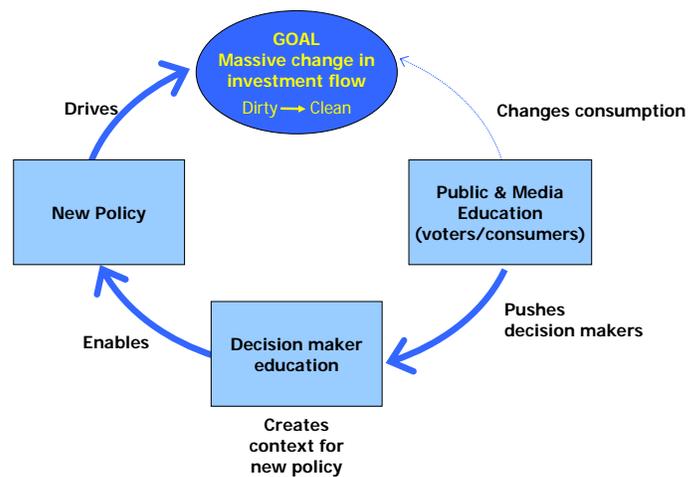
The ultimate goal is a change in investment flows to support low-carbon markets. The recommendations in preceding chapters reflect the primacy of policy in altering business and investment decisions. To ensure that climate policies are adopted and as effective as possible, philanthropists can pursue a variety of tactics (Figure 23). Educating voters and consumers through the media can build political support for reforms. Supporting technical analyses and translating the findings for opinion leaders and decision-makers can improve the caliber of the resulting policies.

While the list of actions needed is relatively short, achieving success requires deep knowledge of local conditions and each sector’s special dynamics. We also must account for the capacity and interests of individual countries and not assume that we can directly import institutional models and public policies from one nation to the next.

With this in mind, philanthropists are recommended to pursue the following three investment options:

- **Support existing NGOs with deep knowledge of local conditions and needed strategies; create new organizations as necessary.** In many critical sectors and countries, philanthropists will find there

FIGURE 23: Philanthropy Has Multiple Entry Points



are already organizations developing solutions that are grounded in a solid understanding of indigenous politics, policies and public opinion. In other cases, additional NGOs may be necessary to develop new, innovative approaches.

- **Create new, nation-specific organizations to facilitate grant-making.** Organizations that have the local capacity and expertise to engage in highly leveraged, strategic grant-making are necessary. Taking a cue from the Energy Foundation’s efforts in China, we must create new programs in the E.U., India and elsewhere to promote climate change strategies across a broad range of sectors.

- **Build International Best Practice Centers for critical “don’t lose” sectors** to accelerate the diffusion of knowledge and innovation, either by establishing a new institution or linking existing organizations in a loose network. Several examples have been provided throughout the sector chapters above.

Philanthropy can call upon a strong tradition of leveraging limited resources to create lasting solutions to a variety of problems, including climate change (Figure 24). In China, a philanthropic investment of about \$6 million has already prevented nearly 1 gigaton of emissions by creating new efficiency standards for top industrial firms, household appliances and light-duty vehicles.

Philanthropy must be willing to make a long-term commitment to effect change and provide support commensurate with the challenge. It took us more than two centuries to dig this deep hole, so it will take some time and effort to climb back out. But we only have one chance to get this right. All of the strategies we have examined carry some element of uncertainty, but none of the choices are as risky or costly as doing nothing at all.

FIGURE 24: Past Successes Show Potential of Highly Leveraged Investments

Target intervention	Philanthropic investment \$ Millions	2030 CO ₂ e reductions Million t	Philanthropic return tCO ₂ /\$	Private sector investment/ savings
Fight conventional coal plants in the US	16.0 (5.3 per year)	270	17	N/A
Support development of US state and federal renewable portfolio standards	23 .0 (2.6 per year)	550	24	\$85 billion for 20% RPS
Support China light-vehicle efficiency standards	2.5 (0.4 per year)	240	97	N/A
Improve “Top-1000” industrial efficiency in China	1.2 (0.4 per year)	590	507	N/A
Support development of US national appliance standards	12.0 (0.9 per year)	330	28	\$186 billion net consumer benefits by 2020
Support development of China appliance standards	3.5 (0.4 per year)	130	38	N/A
Support tightening of US federal CAFE standards	25.0 (1.9 per year)	500	20	\$17 billion annual capital investment by automakers

Source: Based on input from Energy Foundation

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